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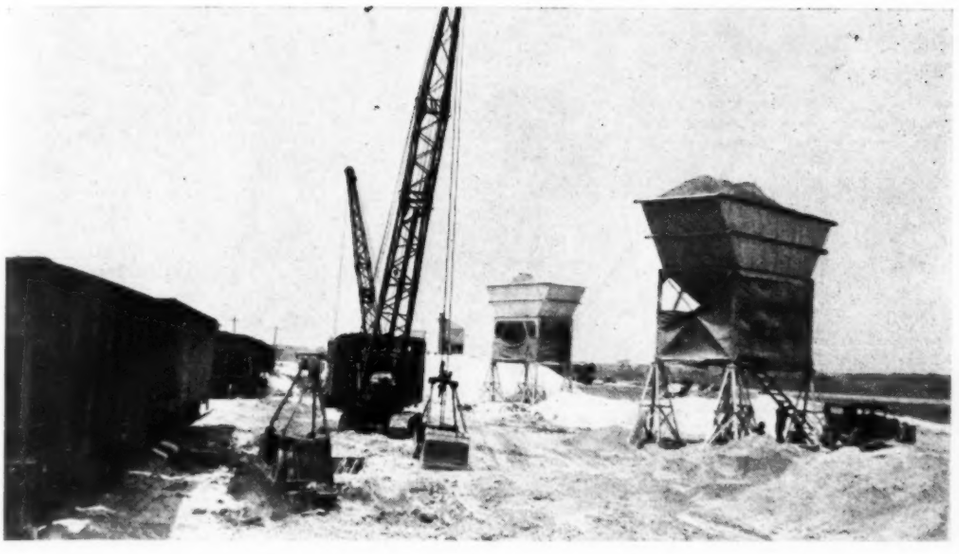


A batch leaves this plant layout every forty seconds. The proportioning plant is designed to handle twenty cars of materials per working day

TWO PAVERS COOPERATE TO POUR CONCRETE SLAB

Coordinated Equipment Produces Batch Every Forty Seconds

By VICTOR J. BROWN

Publishing Director, Roads and Streets

"IT WON'T WORK," they said, but Mr. R. B. "Dick" Harper, General Superintendent for Contractor Thos. McQueen of Forest Park, Ill., is doing it. What? He's pouring a concrete paving slab with two 27E pavers working cooperatively. He's also pumping water 7 miles through a 3-in. pipe line. One paver can turn out only 360 batches in 8 hours under the Indiana mixing time specifications. That is only about 800 feet of finished paving. The contractor can work only 8 hours a day or 40 hours a week. One paver would require a full complement of batching, grading, trucking and finishing equipment and the men necessary to operate the units. By adding another paver, Mr. Harper is able to nearly double the output with the addition of one more puddler and a cement finisher. In other words, he is getting 1200 to 1400 ft. of paving instead of less than 800 ft. per day.

General.—The pavement design is for a dual highway from Schererville to Deep River, Indiana; a relocation of Route U. S. 30, the Lincoln Highway across northern Indiana. McQueen's job is 7¼ miles of this dual highway beginning at a point about a mile south of Merrill Village and extending eastward. Each side of the dual highway is a 22-ft. slab with a weakened plane longitudinally down the center. The two slabs are 66 ft. apart center to center. The cross section of each slab is 9 in.-7 in.-9 in., of thickened edge design. Welded steel mesh reinforcing is placed 2 in. from the top. Dowel bars across the center are placed every few feet. Transverse Translode joints are regularly spaced. These are preformed steel—bituminous filled joints with short shear dowels built-in to carry the supported load across the joint. A view of this joint is shown.

The contractor's plan of operation is to pour the north slab first clear to the east end, then return all equipment to the west end for building the south half of the dual

Two 27E pavers, cooperatively, place all the concrete. The pavers work outside of the forms. Thirty foot booms are provided so that both pavers can place concrete above or below the steel. Both pavers move toward right of picture

highway. In this way it is expected that the newly laid slab can be used for trucking, it will have had its 21 days of curing.

Batching Plant.—Two Blaw-Knox bins and batching hoppers, a Blaw-Knox cement bin and batcher, a Lorain 75-B crane and a Northwest ¾ yd. crane make up the principal parts of the central proportioning plant. The plant is set up along the Chesapeake and Ohio tracks, where siding long enough to hold forty cars of aggregate and six cars of cement was built.

Calculations indicated that 20 cars of aggregate would

Separate bins with attached batchers are used for coarse and fine aggregates. Aggregate from hopper bottom cars dumps into pits under the siding from which it is raised by clam shell buckets into the bins or on the stock piles as required

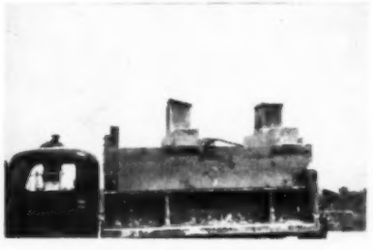
be used daily. The aggregate is dumped from hopper bottom cars into a pit, shown in an accompanying picture, from which clam shell cranes hoist the materials into batcher bins. One triple bin is used for coarse and one for fine aggregate. Small stock piles are made when the bins are full. When working at capacity of the pavers, a batch must leave the proportioning plant on the average of one every 40 seconds. At the time the writer was on the job capacity was not being attained because of a 25 minute loss in the morning at the cement

View of aggregate pit from top of gondola. From this pit aggregate is lifted by clam shell buckets to bins and stock piles

Bulk Universal Atlas portland cement arrives in covered gondolas. It is elevated into a Blaw-Knox bulk cement bin and proportioning hopper. Compressed air is used to loosen or fluff-up cement when unloading. Two batch Wood hydraulic dump bodied trucks with cement containers for each batch pass through at the rate of one batch every forty seconds

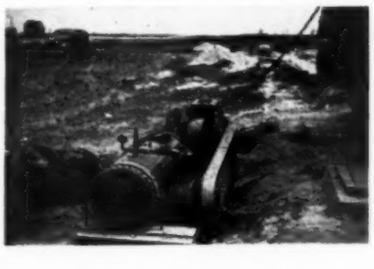
hopper.. The plant layout requires a good road routing for the two-batch Wood hydraulic hoist dump body Ford trucks, of which 13 were required to keep the mixers going on the average mile haul.

Rough and Fine Grading.—The road had been graded and fills allowed to settle. All bridges are complete on the 7¼ miles. Rough grading for the paving

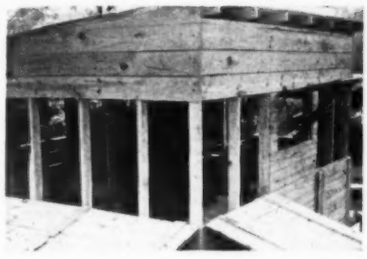


Two batch Wood hydraulic dump bodies keep batches moving uniformly. Bulk cement used is carried in the steel containers shown

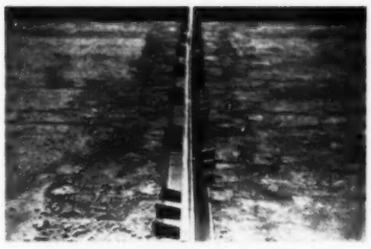
operation is handled by a Caterpillar tractor that pulls either a tandem grader or Killifer rotary fresno as required. This is followed promptly by a Cleveland form-grader. The latter works to a tolerance of ½ in. in grade and 2 in. in alignment. The form setting crew follows closely and keeps about 300 ft. of forms ahead at all times. A flat bed truck hauls Blaw-Knox forms from the previous day's work and spreads them out for the form crew. As 50 or 60 ft. of forms are completed an R-B subgrader prepares the fine grade, casting excess dirt outside of the forms. Next follows a small Austin 3-wheeled roller. The subgrade is then tested with a Carr scratch template and approved by the state inspector. A crew of 3 men then install prefabricated Translode transverse bituminous filled steel expansion joints. The top of the joint is checked with a template cut to the crown of the slab from a piece of 3-in. plank. An accompanying picture shows the joint. The con-



Air compressor unit used to fluff-up cement for ease in unloading and handling



View of pumphouse on Deep River. This Gorman-Rupp R125 Special triplex road pump is working against a 350 lb. per square inch pressure and pushing water for 6½ miles through a three inch pipe line to the mixers.



Prepared transverse Translode expansion joints are spaced regularly. These are made of sheet steel separated by one-half inch of bituminous filler. Note shear transfer lugs. Dowel bars are not used at transverse joints in this method of construction

tractor's bid price was 55 ct. per foot of joint, installed. No dowel bars are placed through this joint. It is held firm by L-shaped steel pegs driven into the subgrade with the base of the bottom leg of the inverted "L" resting on top of the joint. These are pulled after the concrete is dumped on both sides of the joint. The subgrade is now ready to be wet down and receive the mixed concrete.

Concrete Placing.—As stated before, two-batch trucks haul the proportioned mix from the proportioning plant to the mixers. Thirteen trucks are required on the one-mile haul.

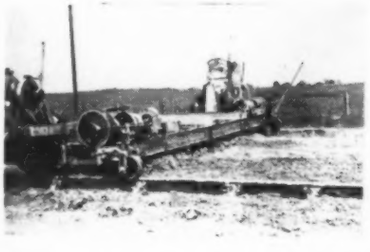
Mixer and subgrade wetting hose connections. Outlet connections are spaced 600 ft. apart on the 3 inch pipe line. Mixer hose is two inch rubber hose

Although Contractor McQueen owns a fleet of big Mack trucks, he is hiring the hauling units for this job. A truck dispatcher directs incoming trucks to the mixers and keeps the traffic moving.

Two 27E Koehring pavers work cooperatively in placing the concrete. The same mix is used above and below the steel mesh reinforcing, so that a truck may be directed to either paver. The pavers are about 25 ft. apart and work outside of the forms. Accompanying pictures show the setup. Water is pumped to the pavers from Deep River, 6½ miles east, through a 3-in. pipe line by a Gorman-Rupp R125 Special triplex road pump. Pressure at the pump is 350 lb. per square inch. A lower pressure would serve just as well. The pavers are getting the water at 80 lb. per sq. in. while a 2-in. stream is flowing through the relief valve 7 miles from the pump.

Two mixers working together place the concrete. The one shown here is the first one. This view shows the Cleveland screed striking off the concrete two inches below the surface. The screed is pulled forward by the power take-off mechanism provided on the paver. Note the boom arrangement devised on the job, which is attached to the carrier frame of the paver, for pulling the screed. The man at the corner of the mixer operates the power take-off and also wets down the subgrade. State Inspector Creager is riding one end of the screed

A formgrader follows rough grading which is done with a Caterpillar tractor and tandem grader. The latter is often replaced with a Killifer rotary fresno. The formgrader works to a close tolerance



After forms are placed an R-B subgrader prepares the fine grade. Blaw-Knox forms are used throughout

Following the subgrader, the fine grade crew checks their work with a scratch template after the grade is rolled

The pavers are equipped with 30-ft. booms, so they may work together and reach back, in the case of forward mixer, or ahead, in the case of the rear machine, to place concrete where needed.

A Cleveland screed set to strike off the fresh concrete 2 in. below the surface operates on the forms between the pavers. Welded wire mesh reinforcing squares are

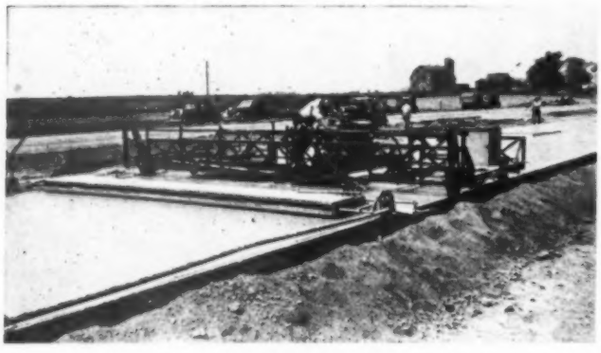
After the screed is pulled, welded wire reinforcing mesh is placed in two flat squares on the struck-off concrete, two inches below the finished surface. Two men handle the steel

The second paver pours the top two inches after the steel is placed. A gas-electric finishing machine follows closely; it keeps up with the pavers and has time to spare. A disc attachment on the rear cuts a longitudinal groove in the finished surface on the center line

placed on the struck-off concrete. Two men handle the steel.

On the frame of the forward paver, the contractor attached a boom device for pulling the screed forward with the power take-off provided on the paver. This device is shown in accompanying pictures. The man who waters the subgrade operates the power take-off for pulling the screed forward.

After the reinforcing mesh is placed the rear paver pours the top 2 in. and helps place base concrete after the top is filled. Close cooperation is needed between the paver operators on this work. One less puddler is required for the two pavers working together than when working separately.



A finisher's bridge rolls along behind the finishing machine and is followed by a flexible joint placing machine. This unit inserts a bituminous sandwich joint a depth of two inches in the groove made by the disc of the finishing machine ahead, which is enlarged by the joint placing machine

Finishing.—Immediately following the placing of the top concrete a Blaw-Knox gas-electric finishing machine strikes, tamps, and belts the surface. The contractor has added a disc device on the rear of the finisher for cutting a longitudinal line down the center of the 22 ft. slab. The line can be cut only 2 in. deep beause it strikes the reinforcing mesh at that depth. One man assists the finishing machine operator in keeping mortar in front of or away from the strike template. This machine easily keeps up with concrete placing and has time to spare. The writer watched concrete placing and finishing when 610 ft. was completed between 8:00 a. m. and 12:10 p. m. with a 25-minute time loss in the morning. This is paving at the rate of about 163 ft. per hour. Over 1200 ft. were poured and finished that day. It was the first full day of operation. When the job begins to run smoothly the maximum output of the pavers is anticipated to be a regular result.

Following the finishing machine is a Cleveland finishers bridge. Six finishers do the trimming, edging, and brooming. The next machine is a Heltzel Flexplane that installs a ½ in. by 2 in. bituminous expansion joint longitudinally in the surface groove made by the disc on the machine. Superintendent Harper is quite pleased with the economy of this operation. After the surface is broomed it is covered with burlap mats that are kept wet. They stay in place for one day and the surface is then covered with straw for curing which is kept wet for 10 days by continual sprinkling. For sprinkling, Contractor McQueen mounted a 1200-gal. tank on an International truck chassis. On the rear end of the tank he attached 24 ft. of 2-in. and 1½-in. pipe in which holes were drilled for sprinkling. The pipe was swiveled so it could fold up along side of the tank for long moves.

Straightedge finishing follows the joint machine; then the surface is broomed before covering

Placing burlap mats over the first day's run. These are wet down by hose

Sprinkling the curing straw during the curing period. A 1200 gal. tank improvised on an International truck chassis works continually. Note the 22 foot sprinkling bar attached to the tank

Roy Creager, State Inspector, left, and R. D. "Dick" Harper, Gen. Supt. to Thos. McQueen, watch the concrete placing organization

Equipment and Personnel.—All equipment for this job, except the two cranes, is brand new. As stated before, sizes of coordinating units were selected so as to get the maximum production from the pavers. Considerable attention was given to the proportioning plant layout in order that as short a boom swing as possible could be obtained for the cranes.

The work is under the supervision of Mr. Oliver Downs, District Engineer, Indiana State Highway Commission. The job superintendent is Mr. Alex Metz. Mr. R. D. Harper is general superintendent for Thos. McQueen Co., contractor. Mr. Roy Creager is the state inspector.

CHEMICAL ASPECTS OF MANUFACTURE AND USE OF PORTLAND CEMENT

The Second of a Series of Articles Concerning Cements

By EDWARD E. BAUER

Assistant Professor, Civil Engineering, University of Illinois

IN the first article in this series, there was presented a brief description of the present day procedure in the manufacture of cement. In this article the writer will attempt to describe as simply as possible the chemical aspects of the problems of its manufacture and use, for, indeed, it is truly one of a chemical nature. In the early days production was on essentially a cut-and-try basis; today, because of the fundamental studies made (1) at the Bureau of Standards, (2) by the various cement companies, and (3) under the sponsorship of the U. S. Bureau of Reclamation in connection with Boulder Dam and other large concrete structures, the manufacture of cement is done on a much more scientific basis.

Manufacturers are paying more attention to the chemical constituents of the raw materials than they did formerly, and the working range for the permissible percentages of the various compounds has been reduced in many instances. Previously each manufacturer tried to find one shale pit and one quarry from which all the raw materials could be secured, but today it is not uncommon to find a manufacturer supplementing his major source of supply with additional sources in order to get just the proper blend of materials.

Chemical Compounds.—In order to understand the reasons for the choice of certain raw materials, it is necessary for us to know first what is desired in the finished product. Authorities appear to be fairly well agreed that the calcium silicates are the compounds that develop strength. These exist in the cement as dicalcium silicate ($2C_aO{\cdot}SiO_2$) and tricalcium silicate ($3C_aO{\cdot}SiO_2$). They are not the only compounds formed, the two more important other ones being tricalcium aluminate ($3C_aO{\cdot}Al_2O_3$) and tetracalcium aluminoferrite ($4C_aO{\cdot}Al_2O_3F_2O_3$).[1]

As pointed out in the first article (May ROADS AND STREETS), cement is made from a combination of calcareous and argillaceous materials. The calcium of the calcium silicate comes from the calcareous raw material and the silica from the argillaceous raw material. The latter is an aluminum silicate and, therefore, there is an opportunity for a compound containing aluminum and we have the tricalcium aluminate. Iron is normally present in small quantities in both the raw materials and it combines to form the tetracalcium aluminoferrite.

The chemist, from his analyses of the raw materials, secures the percentages of the various oxides. Then, on the basis of the amount of these oxides in the raw materials, he determines how much of each to use. As a final check, analyses are made of the mixture of raw materials prior to burning and adjustments are made, as pointed out in the first article, until the quantities of the various oxides are within the desired limits. Average values for the oxides in standard portland cements are:

lime (C_aO)	61.5-65.5 per cent
silica (SiO_2)	19.5-23.0 per cent
alumina (Al_2O_3)	5.0- 8.0 per cent
magnesia (M_gO)	5.0 per cent
sulfur anhydride (SO_3)	2.0 per cent
iron oxide	0.0- 4.0 per cent

It is from the percentages of these oxides that the proportions of the various compounds (such as tricalcium silicate, dicalcium silicate, etc.) are calculated, there being no method for their actual determination. The method of calculating which is generally used is that of Bogue and is given in his paper "Calculation of Compounds in Portland Cement." Paper 21, Portland Cement Association Fellowship at the National Bureau of Standards. Practice varies amongst specification writers, some preferring to give limiting values for the compounds while others refer directly to the quantities of oxides. Until comparatively recently nothing was stated in specifications for cement concerning the amounts of the compounds. The manufacturer could vary these as he chose so long as he met the physical test requirements.

Characteristics of Cement Compounds.—It is possible to control the proportions of the ingredients in order to secure the desired amounts of the various compounds. Recent research has shown the characteristics of these compounds, and they are summarized in Table I.

The tricalcium silicate develops high strengths fairly rapidly with only a medium amount of heat being liberated, while the dicalcium silicate develops a high strength slowly and with a resultant low amount of heat

TABLE I. COMPARISON OF CHARACTERISTICS OF MAJOR CEMENT COMPOUNDS*

Characteristics	*Tricalcium silicate*	*Di-calcium silicate*	*Tricalcium aluminate*	*Tetracalcium aluminoferrite*
Cementing value	Good	Good	Poor	Poor
Rate of reaction	Medium	Slow	Fast	Slow
Amount of heat liberated	Medium	Small	Large	Small

*Carlson, R. W., "Development of Low-Heat Cement for Mass Concrete." *Engineering News-Record*, Vol. 109, pp. 461-436 (1932).

TABLE II. COMPARISON OF CEMENTS

Under fineness, percentage values are for the proportions passing the No. 200 sieve. Other values are specific surfaces, sq.cm./g.

Cement	Major Compounds: Tricalcium silicate	Dicalcium silicate	Tricalcium aluminate	Tetracalcium alumino-ferrite	Fineness	Heat of Hydration at 28 days Cal./g.
Probable Average of 1890[1]	31	36	18	...	80%	90
Typical Portland Cement of 1932[1]	55	23	11	...	90%	100
Pine Canyon Dam, 1932[1]	30	46	5	...	92%	75
Boulder Dam Specifications[2] A	...	60 max.	5 max.	...	1300-1700	70 max.
Boulder Dam Specifications[2] B	60 max.	...	8 max.	...	1200-1600	100 max.
Norris Dam[3]	40.2	33.0	6.4	14.6	95%—1814	...
A standard cement, 1937[4]	53.7	22.2	7.0	11.5	97%—1800	...

[1]From Carlson's "Development of Low-heat Cement for Mass Concrete," *Engineering News-Record*, Vol. 109, pp. 461-3 (1932).
[2]From the specifications.
[3]From Freeman's "The Present Status of Type B Cement After One Year's Experience," *Pit and Quarry*, Vol. 28, No. 1, pp. 35-8 (1935). Values given are typical test results.
[4]A cement from the Eastern part of the United States. Data furnished by manufacturer.

liberated. Tricalcium aluminate develops a small amount of strength but does it in a hurry and with the release of a large amount of heat. The other compound, tetracalcium aluminoferrite is relatively unimportant since it develops a small amount of strength slowly. The tricalcium aluminate hydrates chiefly in the first day; the tricalcium silicate within the first week. It would appear then that most of the strength developed during the first day is from the tricalcium aluminate, and that in the so-called high-early-strength cements, the early strength is from the tricalcium silicate. The full possibilities of strength from the dicalcium silicate are not, as a rule, realized because the concrete is allowed to dry out before much of it has been hydrated.

Comparison of Cements—It is interesting to note the changes that have been made in the proportions of the major compounds. A tabulation for various cements is made in Table II. According to Carlson the cement made about 1890, which was in the early days of American manufacture, was low in tricalcium silicate and relatively high in dicalcium silicate and tricalcium aluminate. Such a cement produced strength slowly and we find all our strength tests in those days were made at 28 days, largely because strengths at earlier ages were too low to be considered. The habit of testing at an age of 28 days persists today to some extent because it was so firmly established years ago. Necessity for greater speed of construction during the war and the subsequent reconstruction period caused manufacturers to produce a cement which would develop strength much more rapidly than did our early cements. Today our standard cement is one with a comparatively high tricalcium silicate content and a low dicalcium silicate content.

Bates[2] points out the same general trend in a tabulation of the analyses and constitutions of cements of the period 1909-18 with the same brands of cements for the year 1932. In a few cases, however, manufacturers in 1932 were producing cements lower in tricalcium silicate than in the earlier period.

Heat of Hydration.—When cement hydrates there is a release of a certain amount of heat. This released heat raises the temperature of concrete over and above the average temperature of the materials used. It is a well-known fact that materials change their volume with changes in temperature. In the case of large masses of concrete the heat generated has little opportunity to escape quickly. In the formative stage the concrete acquires a certain size due to this extra heat. Over a long period of time the temperature of the concrete may be reduced with a consequent reduction in volume. This reduction in volume, in general, is undesirable in large masses of concrete, and so, for such structures as Boulder Dam, a cement was specified which would produce a minimum amount of heat. Type A is the low-heat cement, while Type B is known as a moderate-heat cement. The cement used on Norris Dam was of the latter type.

The heat hydration is determined by placing a small quantity of cement and water in a container known as a calorimeter, which is very well insulated, and then measuring the rise in temperature. From these data the number of calories of heat generated per gram of cement can be computed. Heat-of-hydration determinations are also often made at seven days.

Development of Compounds During Burning.—For those interested in the development of the chemical compounds during burning, the generalizations of Bogue[3] are of interest:

1. Tetracalcium aluminoferrite is formed first through a combination of the ferric oxide (Fe_2O_3), alumina (Al_2O_3) and lime (C_aO).
2. The excess alumina then reacts with the lime (there being some excess) to form tricalcium aluminate[4] ($3C_aO{\cdot}Al_2O_3$).
3. The lime remaining now combines with silica to form dicalcium silicate. If there is any lime uncombined (and there always is) it combines with some of the dicalcium silicate to form tricalcium silicate. Any uncombined lime now remains as such in the cement.
4. The magnesia remains essentially in the form of uncombined magnesia (M_gO).

Hydration of the Cement.—It has, of course, been known that when water is mixed with portland cement the resultant mass becomes hard and has a certain amount of strength. While water is an essential element in the development of strength, too much of it will result in a weaker concrete. The studies of (1)

[1]See Bogue, "A Digest of the Literature on the Nature of the Setting and Hardening Processes in Portland Cement," Paper 17 of the Portland Cement Association Fellowship at the National Bureau of Standards.
[2]See Bates, "Portland Cement Today and Twenty Years Ago," *Engineering News-Record*, April 20, 1933.
[3]See Bogue, "Calculation of Compounds in Portland Cement," Paper 21, Portland Cement Association Fellowship at the National Bureau of Standards.
[4]Abrams, "Design of Concrete Mixtures," *Bulletin 1*, Structural Materials Research Laboratory, Lewis Institute.
[5]Talbot and Richart, "The Strength of Concrete—Its Relation to the Cement, Aggregates, and Water," *Bulletin 137*, Engineering Experiment Station, University of Illinois.

Abrams[4] and (2) Talbot and Richart[5] indicate that the strength of the concrete is a function of the quality of the paste. The Abrams' method of measuring quality is by the ratio of the volume of mixing water to the bulk volume of the cement, a function known as the water-cement ratio, while the Talbot-Richart method is on the basis of the proportion of cement in the cement paste. In the latter case the volume of the cement paste is considered that part of the volume of the concrete not occupied by the aggregate. Both general statements concerning the strength relationships assume certain materials and conditions of test and concrete of a workable plasticity.

What takes place chemically has been the subject of considerable research in recent years and, even though all are not agreed, progress has been made in the development of a workable theory. Henri Le Chatelier advanced a crystallization theory in 1887 and William Michaelis, Sr., a colloidal theory in 1906.[1]

Briefly the crystallization theory is that the cement is dissolved in water to a limited degree. The dissolved portion reacts with water to form a higher hydrate, which in turn is precipitated owing to its lower solubility and the consequent development of a supersaturated solution. During this precipitation very small but elongated crystals are formed which favor interlacement and large surfaces of contact. The precipitated crystals possess high cohesive and adhesive qualities.

The colloidal theory of Michaelis assumes first a solution of lime, aluminates, sulfates and other compounds of the cement, from which are precipitated various crystalline products, such as calcium aluminate, calcium sulfo-aluminate and calcium hydroxide. When the lime water has reached a certain concentration, it reacts with the silicates to form hydrated calcium silicate, which forms a gel filling the pores of the cement. The gel, which is soft in the beginning, is hardened by the withdrawal of water from it by the cement grains.

Our conception today is to some extent that of Michaelis in that it is based on the idea of a gel being formed. Brown and Carlson are of the opinion, however, that "the strength of portland cement is probably developed by the gel acting as a void-filling glue, rather than by any type of crystallization."[6] The mixing water hydrates the cement grains, two products resulting from the calcium silicates which normally represent about 70-75 per cent of the cement: (1) crystalline calcium hydroxide, $C_a(OH)_2$, which is white, and (2) a non-crystalline material called a gel. Brown and Carlson, in their petrographic studies,[6] found that "the less the calcium hydroxide observed in a thin section, the greater the corresponding strength." It is this gel, therefore, which is the cementing agent and "which may be pictured as an intricate, brush-like frame built or grown from compact grains of cement."[7] When hydration of the cement is not completed, there are, of course, grains of cement throughout the gel.

Carlson estimates that the water requirement for the formation of the gel is about three times as much as is needed for chemical combination with the cement, the latter being about 10 per cent of the weight of the cement.[7] These values are about equal to 1.1 gal./sack for chemical combination and 3.3 gal./sack for the formation of the gel. Requirements of workability call for about 5½ to 7½ gal./sack, so there is no danger that we might ever mix the concrete with too small an amount of water.

Studies have indicated that this gel is developed over a period of time, and that it improves as far as density, strength and volume changes are concerned, as more and more of the calcium silicates are hydrated. The tricalcium silicate hydrates rather rapidly, while the dicalcium silicate hydrates slowly.

The gel produced by the hydration of the two compounds appears to be similar, although that from the dicalcium silicate is likely to be more porous at the early ages. Fine cement and a small water content produce a less porous gel than do a coarse cement and a large water content.[6] The continued development of a denser gel depends, of course, upon the presence of water for the further hydration of the calcium silicates. The importance of curing moisture takes on a new significance as we understand better its purpose.

[6]Brown and Carlson, "Petrographic Studies of Hydrated Cements," *Proceedings*, A.S.T.M., Vol. 36 (1936), II, pp. 332-350.

[7]See Carlson, "The Function of Water in Hardening Concrete," *Proceedings*, Highway Research Board, Vol. 16, pp. 216-219 (1936).

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Gasoline Tax Bill Has Doubled Since 1929

Motorists of the United States are paying twice as much money in the form of gasoline taxes into the state and federal treasuries as they did in 1929.

Although 1929 was the first year in which state gasoline taxes for the country as a whole equaled motor vehicle registration fees, so generally have gasoline tax rates been increased during the past few years that state gasoline levies now cost the motorists almost twice as much as do motor vehicle registration fees. In 1936 state gasoline tax receipts totalled $691,420,000, or almost double the $359,783,000 collected by the states in motor vehicle registration fees.

Since 1932 the federal government has been levying a duplicating tax on gasoline. Last year this tax cost $186,321,000, so that the motorists of the nation paid a total of $877,741,000 in gasoline taxes, or more than twice what they paid in the boom year of 1929.

How state gasoline taxes have grown to be the major form of automotive taxation is shown in the following table giving registration fees and gasoline taxes collected by the states since 1923:

Year	State Registration Fees	State Gasoline Taxes
1923	$188,970,000	$ 38,566,000
1924	225,492,000	80,442,000
1925	260,619,000	148,358,000
1926	288,282,000	187,603,000
1927	301,061,000	258,838,000
1928	322,630,000	304,871,000
1929	347,843,000	431,311,000
1930	355,704,000	493,865,000
1931	344,337,000	536,397,000
1932	324,273,000	513,047,000
1933	302,715,000	518,195,000
1934	312,929,000	565,027,000
1935	322,481,000	616,851,000
1936	359,783,000	691,420,000

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HIGHWAY SIDEWALKS IN MASSACHUSETTS.—Massachusetts' 500 mile program of bituminous sidewalks along state highways has employed 12,000 jobless men. The widths vary from 3½ ft. in rural locations to 7 ft. in built up urban sections where streets are flanked with stores and office buildings. The surface in all but a few locations is plant-mixed bituminous concrete, principally of the hot-mix type.

Tasquillo River Bridge, 180 *Kilometers North of Mexico City.*

Mexico's Portion of the

Pan-American Highway

OTTAWA to Buenos Aires—26,000 kilometers, or 16,000 miles, including branches to certain South American countries not crossed by the direct route—is the plan for the Pan-American Highway. Its significance needs little comment, for probably no single factor can contribute so much to increased understanding and friendship betwen English speaking and Spanish speaking Americans.

The growing love for travel to ever increasing distances is an indication (probably far inadequate) of the traffic to be expected. The following general description of the route is from the account presented to the American Road Builders' Association at its convention in January, 1937, by Vicente Cortes Herrera, C.E., Undersecretary of Communications and Public Works of the Mexican Government:

"The Pan-American Highway, as originally planned, is to start from Ottawa, in the Dominion of Canada, and will run through the following nations: the United States and Mexico, in North America; Guatemala, Sal-

Panorama Showing Jacala and Grade Development of the Highway

vador, Honduras, Nicaragua, Costa Rica and Panama, in Central America; and finally Colombia, Ecuador, Peru, Chile, and the Argentine, in South America, the city of Buenos Aires to be the southern terminal of the highway; but in order to join up all the nations, branches are proposed from Colombia and Peru to reach Venezuela, on the one hand, and Bolivia and Brazil on the other."

"In general terms we may say that one may even now, at any time of the year, travel down the portion already built from Ottawa to the City of Mexico, about 3,604 miles, over perfectly finished roads. South from the City of Mexico there is a stretch of 50 miles between it and Cuautla on which the road is surfaced and permanent culverts are in, that may in consequence be traveled over at any season of the year. Beyond Cuautla, in our State of Morelos, there are 16 miles of grading,

Tasquillo River—Old Bridge as Seen from the New

as far as Jonacatepec; there are 12 more miles or so of grading surface in the State of Oaxaca to Mitla; and lastly, in our southernmost State of Chiapas there is a section of 72 miles, between Las Cruces and Chiapa de Corzo, on which earthwork, culverts and surfacing are almost complete at this date. In Central America there are several sections that are passable, some of them only in dry season and others all the year around; in South America, between Colombia and Ecuador, there is a stretch reaching to Quito, the capital of the latter republic, that is passable at any season of the year, and lastly, one may take it for granted that the run from Peru down to Buenos Aires is only passable in the dry season over roads in fair condition for travel."

No time for completion of the highway can as yet be set. Less than a generation seems probable: much less reasonably possible. The greatest difficulties lie, of course, in South and Central America, and in some instances these difficulties are political as well as physical and financial. Of their ultimate solution, however, there seems no reasonable doubt. In Central America the United States Government has given valuable assistance, especially in connection with bridge construction.

The Old Model Burro Helps Build the Motor Road.

Work Remaining in Mexico

Mexico plans the completion of her portion in the year 1940, and has made provisions which seem adequate for the purpose. The main uncompleted section is that from Mexico City to the Suchiate River on the Guatemalan boundary, a distance of 1,443 kilometers, or slightly less than 900 miles. The cost of this work is estimated at about 120,000,000 pesos—the equivalent of $34,000,000 in United States money.

An outline of what is to be done and the general scheme of proposed operations is given in the following three paragraphs from Mr. Herrera's summary:

"In view of the magnitude of the sum in question, it will be indispensable that construction of this highway be taken in hand on as many different points, so to speak, as possible, and to this end a study has already been begun of highway and railroad communications that will allow satisfactory handling of machinery, equipment, implements, staff and labor. In general terms and for location of this road, the first idea was, after leaving the City of Mexico, to take it through Puebla, Tehuacan and Huajuapan de Leon, in the State of Oaxaca; subsequently, however, and in spite of the fact that the route in question would afford the advantage of being able to utilize a 160-mile road completely paved to Tehuacan, Puebla, yet it was deemed better to locate the road directly through Amecameca, Cuautla, Metamoros and Acatlan, in the State of Puebla, to reach Huajuapan de Leon by this shorter route; as thus located, the highway will cross the States of Mexico, Morelos, Puebla and Oaxaca."

"It will be possible, thanks to experience gained on other projects previously developed by the Federal Government, to adopt a program for work that will enable the portion between Mexico City and the Guatemalan border to be completed within the time set, and that will, furthermore, satisfy the road needs of the various sections the highway will pass through. In drawing up this program the general conditions of means of communications throughout the country, the obligations laid upon our Government by the Six Year Plan, and the financial possibilities of the Federal Government, will all be taken into account. The basis of this program will undoubtedly have to be determined by the imperative necessity of joining up those portions of the route at present cut off from one another, it being therefore likely that the first thing done will be the building of the portion from Oaxaca to San Jeronimo and that from Chiapa de Corzo to Tapachula and Talisman (on the

Finishing Touches to Construction.

Guatemalan border), as this will practically establish a coordinated railroad and highway transport system along the whole length of the proposed route. Construction of the highway will be pursued unremittingly with a view to having an uninterrupted highway along the longest sections possible. However, to meet the wishes of the Federal Government that this section of the great highway be finished throughout to the surfacing stage by 1940, construction work will have to begin at a number of different points that will be strategically selected, both in view of the requirements previously set out, and to enable easy transport of machinery, equipment and personnel."

"Technical considerations will make it very difficult to construct the whole of the Mexico City-Suchiate Road through up to oil paving, within the period of four years yet lacking before General Cardenas' term of office expires, for this would involve, in round numbers, the paving of 870 miles of highway; it would furthermore be necessary to wait until earthwork and grading are settled down and consolidated properly; so it is deemed impossible to carry out the whole of this work within the period mentioned. However, it is hoped that this road will be completed throughout two years after the expiration of the Six Year Plan, while total cost, including paving, has been estimated at one hundred and twenty million pesos. These figures are based on capacity at present shown by work on a contract basis, natural conditions along the route, and work so far done, either for the exclusive account of the Federal Government or under the Law on Cooperation, April 20, 1934, in the States of Morelos, Oaxaca and Chiapas."

From Rio Grande to Mexico City

The 1,226 kilometers (762 miles) from Laredo, Texas, to Mexico City, is now in excellent condition, as tourists are rapidly finding out. Some short portions still lack bituminous surface treatment, and other improvements, such as guard rail installation, are still in progress, but in these respects it does not differ from many important highways in the United States. So long as improvements are possible no highway is ever quite complete.

Engineering has been of conspicuously high caliber, and the Mexican Government is to be congratulated, not on its good luck, but for its broad-minded foresight in employing so capable a staff. Topography varying from the flat area in the north, where there is a single tangent of 46 miles, to the extensive mountainous section on the approach to Mexico City, provided plenty of interesting, not to say difficult, problems in location.

In Picturesque Tamazunchale

Typical Curve Protection—Plate Type, "Resiliflex," Guard Rail Between Mexico City and Puebla

These have been solved in a common sense way, without running to extravagant construction on the one hand or to cheap and dangerous alignments on the other.

The maximum grade is 6 per cent, the maximum curvature 28 degrees. All curves are well banked. Starting from an elevation of less than 400 feet at Nuevo Laredo, the road makes several substantial rises and dips before reaching the summit of 8,300 feet, some sixty-odd miles north of Mexico City. The city itself stands at an elevation well over 7,000 feet.

Most of the surfacing has been with asphalt emulsion applied in three separate coats to form a one-inch carpet. A short stretch in the north was finished by a mixed-in-place method. The treated width is 6.25 meters (about 21 feet), except on widened curves. In the interest of safety, extensive use has been made of non-skid surfaces, guard walls, steel plate guard rail and center striping.

Further quotations from Mr. Herrera's paper are of interest:

"Though construction work on the rugged mountain section between Colonia and Tamazunchale was begun in 1929, it was not until 1935 that grading was completed, the last portion to be finished being that between the Barranca de los Marmoles and Tamazunchale, on which the work of cut and fill to get a good graded road all along the line was both heavy and continuous. On this section between Pachuca and Tamazunchale is the Tasquillo bridge, a metallic structure 420 feet long over all, and consisting of a single arch of about 295 foot span, being the only one of its kind on any highway in the republic."

"To summarize, at the time of speaking, grading, bridges and culverts and surfacing are complete throughout all along the Mexico City-New Laredo section; as regards oil paving, this has been carried as and when the technical condition of the work allowed, this type of paving being only lacking on a portion about 70 miles long, between Jacala and Matlapa. This stretch of road runs through a very hilly country and it was necessary to wait until a rainy season had passed and earthwork was properly consolidated in order to have a firm foundation for the asphalt coat. Oil surfacing on this stretch of the road is contemplated in the program of work for the early months of 1937, preparations for this work being well advanced, by the process of 'mix-in-plant' oil paving. This piece once finished, the Mexico City-New Laredo section of the highway will be completed from one end to the other.

"In order to have an idea of the magnitude of the work done on construction of this section, it is enough to say

A Carefully Protected "S" Curve in the Mountain Section Between Jacala and Zimapan.

that although it crosses large tracts of level country, no less than 15,000,000 cubic yards of material had to be moved, of which about 50 per cent was earth, 25 per cent loose rock and the other 25 per cent solid rock; almost 3,000 culverts and 168 bridges over 20 feet long had also to be built, outstanding examples of which I shall now proceed to name: Tasquillo bridge, 420 feet span over all; River Moctezuma bridge, 317 feet; Axtla bridge, 518 feet; Coy River bridge, 277 feet; Tampaon River bridge, 565 feet; Guayalajo River bridge, 780 feet; Corona River bridge, 385 feet; Purificacion River bridge, 886 feet, considered the longest bridge on any highway in the Republic of Mexico; Linares bridge, 400 feet; Cabazones River bridge, 395 feet; Montemorelos bridge, 470 feet; and lastly the bridges at Cienaga de Flores and Sabino, 482 and 344 feet respectively."

The road is policed by officers whose purpose seems to be primarily to help motorists, and to restrain or interfere only for good reason. Many if not all of these men speak English, and their uniform courtesy and helpfulness have been a happy surprise to many tourists from the United States.

Probably the most serious lack noticed by Northern motorists is in gasoline and service stations. If you make the trip, remember to keep close track of gas, oil and tires, to say nothing of water, for it's entirely possible to be stalled uncomfortably far from help.

One may choose either speed or leisure, or a mixture of the two, for a motor trip to Mexico. There are magnificent vistas and panoramas which may be caught on the fly, and scenes of exquisite beauty which will repay as intimate acquaintance as one may wish. Good hunting is available under certain definite regulations: the historian, archeologist or antiquarian need have few dull moments. There is a picturesque countryside with strange customs and a strange culture, while the cities offer beauty and gaiety with the charm which is found only in things foreign.

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117-Mile Highway to Encircle Berlin.—A road 117 miles long will be built entirely around Berlin, to divert cross-country traffic from passing through the congested business district. The road is to be opened in sections, and 22 miles of it probably will be ready for traffic this spring. It is expected the entire circle will not be completed until 1940.

Standards of Highway Design to Be Developed

Secretary of Agriculture Wallace has announced the appointment of 12 nationally known experts in highway engineering to work with the Bureau of Public Roads in developing standards of highway design to promote maximum traffic safety and highway utility. The work to be done has the full support of the American Association of State Highway Officials, which through its executive committee recently stressed the urgent need of reviewing administrative policies concerning minimum standards for the design of roads.

Meetings of the experts with Bureau of Public Roads officials will be held from time to time to consider matters such as road surface widths, maximum grades and curves, design of multi-lane highways, protection of grade crossings and many other problems that enter into highway construction.

All of the men appointed as consulting highway specialists are state highway officials and members of the American Association of State Highway Officials. They are actively engaged in carrying on large State highway programs involving hundreds of millions of dollars. The standards developed will have immediate application in state and federal-aid highway work.

Thomas H. MacDonald, Chief of the Bureau of Public Roads, will act as chairman of the committee of 12 who are:

C. H. Purcell, State Highway Engineer, Sacramento, Calif.; Ernst Lieberman, Chief Highway Engineer, State Department of Public Works and Buildings, Springfield, Ill.; Fred Kellam, Design Engineer, State Highway Commission, Indianapolis, Ind.; Hugh Barnes, Chief of Highway Planning, State Highway Commission, Topeka, Kan.; G. H. Delano, Chief Engineer, State Department of Public Works, Boston, Mass.; O. L. Kipp, Construction Engineer, State Department of Highways, St. Paul, Minn.; Murray D. Van Wagoner, State Highway Commissioner, Lansing, Mich.; Harold W. Giffin, Engineer of Surveys and Plans, State Highway Department, Trenton, N. J.; R. H. Baldock, State Highway Engineer, Salem, Ore.; P. M. Tebbs, Assistant Chief Engineer, State Department of Highways, Harrisburg, Penn.; Gibb Gilchrist, State Highway Engineer, Austin, Tex.; C. S. Mullen, Chief Engineer, State Department of Highways, Richmond, Va.

ARBITRATION UNDER PUBLIC CONSTRUCTION CONTRACTS

By LAZARUS WHITE

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A BRIEF inquiry into the nature of construction contracts should be of help in this discussion. The first question which comes to mind is "why a contract"? Why not organize a construction department and do work directly? Under certain circumstances that may be the proper course to pursue, but the experience of many years indicates that the contract method is more economical and eliminates many evils connected with construction by day's work, plain to any good observer.

Of course there are evils connected with contracting which are also obvious. However, once it is determined by any community that it is advisable, in the public interest, to contract a certain construction, it is necessary that a reasonable profit be allowed to the contractor, as without this contracting cannot exist; and the contract must not be so drawn as deliberately to deprive the contractor of this reasonable profit. And while he must assume certain business risks, such as rises in wages and costs of materials, risks of bad weather, etc., with good management he usually comes out with a profit.

What Is a Contract?—At this point it will serve to inquire "What is a contract?" No better definition has ever been given than the old Anglo-Saxon one that a "contract is a meeting of the minds"—that both parties agree to a certain statement of facts under which a definite piece of work is to be performed and for which a definite price is fixed. That being the case, it is the duty of the owner, through his engineers and architects, to establish, by adequate investigation, by borings, etc., the conditions under which the work is to be done—especially so as the owner usually takes months or years to plan and investigate his work and the contractor is given only a few days in which to prepare his proposal or bid.

Lack of Investigation Cause of Litigation.—In the writer's experience, the lack of proper investigation is the principal cause of difficulties in the carrying out of contracts and in the subsequent litigation. Especially so where underground work is included, in which case it is expensive to secure the information; but this is not beyond the resources of modern science. As witness, the Catskill Aqueduct, where many dam sites and over one hundred miles of aqueduct line were so thoroughly explored and reported upon by competent geologists that very few surprises were met and little litigation followed a project which involved the expenditure of over $200,000,000.

As investigations and adequate and complete designs are costly, and require considerable time in preparation, owners, public or private, are apt so to restrict the engineer or architect that vague or incomplete plans are offered, with inadequate investigations of conditions, in which case a true "meeting of the minds" is improbable.

The Imperfectly Prepared Contract.—As these defective contracts, as described, have led to extensive litigation, lawyers have sought to build up various defenses or waivers of responsibility for the accuracy of the estimates of quantities, for the information supplied, etc., and have attempted to give complete and arbitrary powers to the engineer or architect. Clauses in which the contractor guarantees the adequacy of the design are common and the contractor is often required to be an insurer for the owner against outside claims for damages—as in excavations—extending over a long period.

Now it can be seen that in the imperfectly prepared contract there is much danger of differences of opinion which often lead to litigation. It can also be seen how difficult it must be to adjust these cases in the ordinary courts. It requires considerable technical ability properly to visualize these cases and this is too much to expect from the ordinary judge and jury, who cannot be expected to be experts in many lines. In the writer's experience, some of the ablest jurists find it difficult to grasp the essence of a construction contract.

As it is too much to expect perfect or near perfect contracts from the usual public body, what then is the remedy? In private contracts, it is much easier to adjust construction differences without recourse to the courts, as those in charge are not bound by complex or limited powers. Often a public official or engineer will privately acknowledge the justice of a contractor's claim, but through limitation of his powers or fear for his position, will officially deny these same claims, hoping that the contractor will be compensated properly by the courts. However, this may not be brought about for several years—particularly when it is a precedent-making case and the public legal departments appeal the decisions over and over again.

Arbitration Clauses Simplify Adjustment of Opinions.—Fortunately arbitration clauses are now commonly to be found in construction contracts. They greatly simplify the adjustment of differences of opinion as to payments. Under this method each side chooses an expert to represent him. They in turn choose a third and the investigation is conducted as in a court, but far more informally. Much time can be saved, as the expert arbitration board can go straight to the point and from their experience evaluate the claims. They are also far more immune to prejudice and worked up sympathy

Arbitration clauses in construction contracts have been in use in the building industry for some years. In fact, the recent revision of the Standard Documents of the American Institute of Architects includes an arbitration provision in the contract and an arbitration plan as a separate document. Arbitration clauses also are employed in contracts for other classes of private construction. However, they are usually not found in public contracts. An interesting discussion of their employment on public works contracts is given by Mr. White in the April issue of The Arbitration Journal, a publication of the American Arbitration Association, from which this article is taken.

and much more liable to render a justly evaluated verdict than an ordinary court. Their decisions are made binding by the laws of many states and are very difficult to upset.

An Example of an Excellent Arbitration Clause.—Unfortunately arbitration clauses are not usually found in public contracts; and where found are usually voluntary and must be agreed upon by both sides. Their use is increasing, however, and it may be of interest to review the adoption of arbitration in public works contracts: An example is the excellent arbitration clause included in the contract for the construction of the Lake Champlain Bridge, between Crown Point, New York, and Chimney Point, Vermont:

> To minimize disputes and facilitate their prompt settlement, it is mutually agreed in Article C hereof that the Engineer shall in the first instance be the interpreter of the contract.
>
> All decisions of the Engineer made in accordance with Article C hereof shall be final except as to the element of time and as to financial consideration involved, which, if no agreement in regard thereto is reached, shall be subject to arbitration under the published Arbitration Rules of the American Arbitration Association and pursuant to the New York Arbitration Law, the parties hereby certifying and agreeing that they have read and are familiar with said rules and said law.
>
> All questions subject to arbitration under this contract shall be submitted to arbitration at the demand of either party to the contract.
>
> Demand for proposed arbitration shall be filed in writing with the Engineer, in the case of an appeal from his decision, within 10 days of its receipt; in the case of any other dispute such demand shall be so filed with the Engineer within a reasonable time after the dispute has arisen; but in no case shall such demand be filed later than the time of final payment except as otherwise expressly stipulated under the contract. If the Engineer fails to make a decision within a reasonable time, an appeal to arbitration may be taken as if his decision had been rendered against the party appealing.
>
> Whenever any dispute between the parties is subject to arbitration as hereinbefore provided, such arbitration shall be demanded by the service upon the opposing party of written notice to proceed therewith within three (3) days after service of such notice.

The Port of New York Authority has employed elaborate provisions for arbitration in a number of its projects, of which the following is an excerpt:

> . . . In any case covered by this clause, either party may demand arbitration by serving a notice upon the opposing party to proceed as hereinafter prescribed within three business days after service of such notice. Subject to the provisions of this clause, the arbitration shall proceed under and pursuant to the rules of the Committee of Arbitration of the Chamber of Commerce of the State of New York, if said Committee will accept the same, the parties certifying and agreeing that they have read and are familiar with the said rules . . .

The Department of Water Supply, City of Detroit, has employed arbitration in the construction of public works to the extent of several million dollars, with the following results, as stated by Mr. Edward W. Frey:

> In a number of instances contractors and the Board took advantage of the arbitration clause and accepted the arbitrators' decisions in the manner prescribed. Of all the contracts entered into by the Board, in no single instance was it necessary to resort to a court of law; considering the magnitude of the sum of money involved in the many contracts let, this achievement takes its rightful place in the history of the Division's activities. In this connection, proper credit should be given the Corporation Counsel's Office of the City of Detroit, for it was through their advice and counsel, that many of the protective clauses were written into the contract documents, and it was through their valued cooperation that many technical questions concerning the law were so interpreted as to protect the best interests of the Board.

Arbitration in the Highway Field.—In the field of highway construction, a survey of the use of arbitration by the different states reveals a wide variety of laws and provisions concerning the settlement of controversies arising out of contracts between state highway departments and contractors.

North Dakota, for example, enacted, in 1927, a law providing for the compulsory arbitration of controversies arising from contracts to which the State Highway Commission is a party. Arbitration has been effected under this law in a number of instances, and in 1936 it was invoked to dispose of differences growing out of the construction of a Missouri River bridge.

In Minnesota, the State Highway Act provides for arbitration in controversies involving the construction and repair of highways; and Iowa has carried an arbitration provision in its Specifications for Highway Work for 25 years, during which period some 30 or 40 arbitrations have been held. Missouri also uses arbitration, although no legislation concerning its use has been passed, and the same is true of Oregon and South Dakota.

In a number of other states there have been established special boards to hear claims: in Ohio, it is the Sundry Claims Commission; in Texas, a Claims Committee; in Illinois, a State Court of Claims, and so on.

The fact remains, however, that the duties of a public official are closely prescribed by the laws and he hesitates to surrender any part of them to an arbitration board. Then again, when a case against a public body involving a large sum is lost in the courts, it does not seem to excite public comment, particularly where the case is appealed, as time dulls the memory of the public. When lost before a board of expert arbitrators, it carries more of a sting and involves a certain amount of risk as to the personnel of the board, its manner of choosing, etc. However, arbitration is the right way—in the public interest, in the interest of justice and for the relief of overburdened courts and, therefore, should be furthered in every legitimate way.

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Traffic Accident Death Totals Reduced in 16 States

The National Safety Council has reported that traffic accident death totals were reduced an average of more than 8 per cent in 1936 by 16 states, the District of Columbia and 116 cities of more than 10,000 population outside those states.

The report showed that cities and states which contributed to the reduction represented at least 42 per cent, or 54,531,349 of the nation's 128,400,000 population.

Had the entire country matched this reduction, the Council said, 1936 traffic fatalities would have numbered 33,372 instead of the all-time high of 37,800 (final revised figure that will stand until U. S. Census Bureau total is announced).

The Council said that the reduction was the more remarkable because it was accomplished in spite of record automobile mileage and the largest motor vehicle registration ever recorded.

There was an 11 per cent increase in gasoline consumption in 1936 that propelled 28,270,000 vehicles 228,000,000,000 miles over American streets and highways—22,000,000,000 miles more than in any other year.

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ROAD EXPENDITURES IN GREAT BRITAIN.—The estimated expenditure on roads in Great Britain during 1936 by the National Government was about $162,500,000. These amounts do not cover expenditures or budgets of the various counties.

EFFECT OF JOB MANAGEMENT ON PRODUCTION RATE ON CONCRETE PAVING WORK

An Analysis of Detailed Field Studies on 77 Concrete Paving Jobs

By ANDREW P. ANDERSON
Highway Engineer, U. S. Bureau of Public Roads

THE rate of production secured from any given concrete paving outfit varies with many factors of which management is apparently the most important. For, while weather and local working conditions, equipment and personnel, as well as specification requirements and their interpretation in varying degrees and from time to time impress their influence on the rate of production, the effect of management is continuous and largely independent of all these factors. Thus, for example, on individual jobs transportation difficulties of various kinds may readily reduce possible production by 10 or even 30 per cent, which poor or inefficient management is likely to accept and condone as an uncontrollable contingency, but which efficient management will simply meet as another difficulty to be licked and its recurrence prevented. Consequently, no matter what other conditions on the job may be, an effective change in the quality of the job management can be expected to produce a somewhat corresponding change in the rate of production. This is perhaps the most important evidence secured from analysis of the detailed time studies of 77 concrete paving jobs. The essential characteristics of these jobs are compiled in Table 1.

From this analysis it is clear that the efficient management of a concrete paving job involves not only the proper selection of equipment and personnel but that in addition it presupposes a special ability for job organization and job control. Job management in order to attain real efficiency must be capable of coordinating the various essential but more or less independent operations involved in the construction of a concrete pavement so that they will all function together as one single smoothly working mechanism for the production of square yards of completed pavement. These latter qualifications are extremely important, for unless the management can coordinate and synchronize the various operations in this manner production rates will be low and unit operating costs will be correspondingly high.

The Mixer the Key Producer

Certain particular difficulties appear to be inherent in the very nature of the work of concrete pavement construction. The mixer is the key producer. Its maximum possible rate of production is definitely fixed by the requirements of the specifications as to the maximum permissible size of the batch and length of the mixing time plus the time required for the mixer mechanism to function in getting the batch in and out of the drum. This maximum possible rate of mixer operation is, however, rarely attained except for relatively short periods at irregular intervals. It can never be exceeded. Average continuous production is there-

Concrete Paving Construction Has Become So Completely Mechanized That the Chief Function of Management Is No Longer the Direction of Workers, But to Maintain the Co-ordinated Operation of Various Interdependent Mechanical Units.

The Construction of a Concrete Pavement Involving Many Separate Operations, All of Which Must Proceed at a Rate Set by the Mixer Without Interfering Either with Each Other or with the Mixer.

fore always at a rate somewhat below this maximum possible rate for the simple reason that entirely uninterrupted mixer production can only proceed when and as all the supporting operations also proceed at the proper rate and in full synchrony with this rate of the mixer. This is a difficult accomplishment. In order to be successful all the materials must be made available and delivered at the exact rate demanded by the mixer, subgrade must also be prepared, forms set, steel and joints placed and the pavement finished and cured at least at this rate. Any interference from any of these supporting operations or any hesitation on the part of the mixer or mixer operator will inevitably be registered as a loss of production on the part of the mixer. Furthermore, these losses are irretrievable. There appears to be no way in which such losses can be compensated. The loss of a batch by the mixer one hour cannot be regained by speeding up of the mixer at some subsequent hour nor can the lost batches from today's lack of sufficient hauling equipment be retrieved by additional hauling equipment tomorrow. Each operation must therefore proceed in exact conformity with the demands of the mixer. Any deviation below this demand is inevitably registered as a definite decrease in production.

On the other hand, production capacity in excess of this rate in any subsidiary operation or process is a useless expense except where it definitely serves as an insurance against probable delays to the key producer. Long experience has thus shown that for the batch-hauling equipment an oversupply of somewhere from 5 to 15 per cent above that normally required to supply the regular maximum production rate of the mixer is generally desirable. But to add more capacity to any operation that required to insure absorption of the expected or probable variations in its rate of operation is generally a sheer waste of effort and money. However, on such operations as preparing subgrade and setting forms where storage or the accumulation of a reserve is possible, the work should be timed to proceed at the average daily rate of the mixer but, where at all possible, with a lead of one or at least one-half day's paving ahead of the mixer.

Sustained Production Important

The importance of sustained production rests on the fact that for any given job every concrete paving outfit has some attainable rate at which unit operating costs will be a minimum for that particular outfit on that particular job. If the plant and organization are properly balanced as they should be, this optimum rate either is or can with slight modifications be made to approach fairly close to the maximum possible rate of the key producer. The key producer must, of course, always be the mixer. To permit some other piece of equipment or other operation to fix the rate of production is nearly always fatal to production costs. The reason for this is that the daily or hourly cost of operating any given concrete paving outfit under any particular given set of conditions is practically independent of the rate of production. Thus if a given outfit is equipped and manned to produce, say, 40 batches an hour at a total operating cost of $40 an hour or $1 per batch, then the hourly operating cost will be practically the same for those hours when production is permitted to drop to any lower rate, say, 20 batches an hour, but the unit operating cost will then be $2 per batch or double that at the maximum rate.

The set-up of the equipment and organization on any particular job thus determines the maximum attainable rate of production and the minimum attainable unit operating cost. How nearly this optimum rate will be attained depends, however, on the efficiency with which the job is managed. For whenever the management permits production rates to fall appreciably unit operating costs will inevitably rise in about the same but inverse ratio.

Consideration of Operations Essential

But in this connection management must keep in mind that any given concrete paving outfit also has a maximum rate above which production cannot go and that this maximum rate is definitely fixed by the mixer operating under the requirements of that particular job. This does not mean that every outfit will always attain this maximum rate of which the mixer is capable. For various reasons, frequently financial stringency or erroneous ideas of economy, many paving outfits never reach the maximum rate of which the key producer is capable. Not infrequently the rest of the supporting equipment or the personnel establishes a maximum at some point more or less below the possible maximum of the mixer. Thus although the maximum possible rate of the mixer may, for example, be 50 batches per hour on a 60-second mixing time requirement, the hauling equipment or the material-handling equipment

TABLE I.—SUMMARY OF OPERATING CHARACTERISTICS AND PRODUCTION RATES AS DETERMINED BY DETAILED FIELD STUDIES ON 77 JOBS

Job No.	Total Available Working Time in Hours	Major Delays in Per Cent of Available Working Time: Due to Weather	Major Delays in Per Cent of Available Working Time: All Other Causes	Tot. Actual Working Time in Hours	Avg. No. Batches Per Working Hour	Average Mixer Cycle in Seconds	Minor Delays, in Per Cent of Actual Working Time: —Hauling— Supply	—Hauling— Operation	— Mixer — Operator	— Mixer — Mechanical	Lack of Subgrade	Steel	Joints	Finishing	Materials Yard: Lack of Materials	Materials Yard: Crane	Materials Yard: Hauling Cement	Water	Miscellaneous	Total Minor Delays
1...	284.2	28.6	7.0	182.95	30.8	86.2	10.1	3.3	1.9	1.1	.1	1.2	3.0	.1	...	.4	...	.8	4.1	26.1
2...	856.7	20.3	22.5	492.58	32.5	68.9	...	18.8	3.3	1.6	1.0	1.9	...	2.5	...	...	4.8	1.1	2.6	37.6
3...	248.5	50.1	6.1	108.89	38.8	74.4	...	7.8	.3	.1	1.1	...	.2	...	...	...	1.4	4.4	4.6	19.9
4...	244.0	27.5	10.0	149.98	36.1	71.8	18.7	5.4	1.6	.6	.7	.1	...	...	...	...	...	...	.9	28.0
5...	375.0	27.5	14.5	217.63	29.4	96.3	6.5	3.9	.3	1.9	1.9	...	...	.3	2.6	.4	.4	1.0	1.1	20.3
6...	568.0	11.7	23.3	369.06	34.2	83.4	3.7	1.7	.9	3.4	3.0	...	.6	1.0	...	...	.3	3.4	2.9	20.9
7...	415.5	13.9	31.4	227.43	23.3	87.2	2.6	5.2	.9	3.2	12.6	.6	1.0	2.5	...	...	...	3.7	11.4	43.7
8...	293.0	15.1	25.7	173.55	30.8	78.3	8.4	1.2	2.1	2.2	7.6	...	.9	1.1	...	...	...	3.2	6.3	33.0
9...	1,431.6	36.2	15.2	695.35	37.1	71.6	7.9	3.4	.7	.9	.7	.9	4.7	.4	.2	...	.1	1.6	4.8	26.3
10...	117.0	...	5.1	111.09	44.0	74.4	.7	.3	1.8	2.0	1.8	...	...	.6	.3	...	.6	.6	.3	9.0
11...	456.0	14.3	18.3	307.38	47.1	72.7	1.1	.8	1.5	.8	...	...	...	...	...	...	...	.5	.3	5.0
12...	240.4	4.4	28.2	162.11	41.0	77.0	.1	1.9	.6	2.5	2.6	...	.1	.5	...	.9	...	1.4	1.7	12.3
13...	544.6	33.1	12.6	295.83	29.8	93.7	9.0	2.8	3.0	3.0	2.0	.2	...	.4	...	...	.1	.4	1.5	22.4
14...	1,055.3	48.1	11.6	425.89	28.0	87.1	8.1	4.1	...	1.7	5.8	1.5	...	...	...	...	...	2.3	8.5	32.0
15...	448.0	55.1	10.4	154.54	29.1	95.0	7.5	.9	.5	.5	1.4	...	...	...	...	...	.3	.5	11.7	23.3
16...	336.0	62.6	3.8	113.14	33.8	89.4	5.2	1.7	.9	.6	3.2	...	...	...	...	...	1.0	.8	2.5	15.9
17...	63.0	...	4.5	60.14	26.6	116.6	1.3	3.5	4.4	...	...	...	...	1.7	...	...	.8	...	2.2	13.9
18...	306.0	49.7	5.3	137.60	44.1	75.6	.5	.2	...	4.6	.6	...	...	...	...	...	...	.8	.8	7.5
19...	313.5	46.0	12.5	130.05	40.1	76.7	.8	6.1	1.1	.3	1.3	...	...	...	...	...	...	3.3	1.8	14.7
20...	286.7	27.5	25.0	136.18	32.6	90.0	13.5	2.7	.7	1.2	1.6	...	...	...	...	...	...	1.0	1.1	21.8
21...	223.2	3.8	26.0	156.67	23.0	132.0	...	3.1	...	5.9	...	...	...	...	1.4	...	...	4.5	.9	15.8
22...	443.4	48.8	5.9	201.43	32.3	87.8	10.5	2.9	.1	1.1	.6	...	...	...	...	...	...	.6	5.5	21.3
23...	475.5	10.9	10.1	375.78	32.5	89.6	8.3	3.5	.2	.5	1.1	.4	.3	...	...	...	...	3.2	1.2	19.1
24...	273.8	32.5	29.2	104.78	32.6	87.6	5.5	1.8	2.3	4.0	.5	...	...	...	...	...	...	6.6	.2	20.9
25...	214.0	.4	13.0	185.41	28.9	84.2	11.4	11.3	1.7	1.9	.2	.5	.1	...	...	...	...	3.5	1.7	32.3
26...	329.0	68.4	6.8	81.70	17.6	88.1	27.2	3.5	7.1	...	2.6	1.3	6.2	...	...	...	4.7	...	4.4	57.0
27...	360.0	45.4	7.0	171.35	34.5	85.7	12.4	2.4	1.7	.4	.5	...	...	...	...	...	...	...	.4	17.8
28...	237.0	27.9	13.8	138.16	26.5	85.9	10.9	6.4	1.5	3.5	9.5	...	...	2.0	...	...	...	3.6	1.9	39.3
29...	310.5	24.0	12.6	196.81	31.3	87.2	6.6	1.5	2.9	...	2.8	.4	...	...	...	...	...	.4	.8	15.4
30...	700.0	23.3	24.0	369.16	44.5	73.0	3.5	2.2	.1	.4	...	...	...	.6	.2	...	.2	1.0	.6	8.8
31...	191.6	12.5	7.2	153.87	56.5	61.3	1.4	.8	.5	.4	...	...	...	...	...	...	...	.5	.3	3.9
32...	191.7	12.5	8.0	156.15	56.6	60.1	2.0	1.0	1.4	.5	...	...	...	...	...	...	...	.6	.1	5.6
33...	370.7	4.1	8.8	322.87	54.9	60.5	2.4	.6	.3	...	...	...	...	...	...	3.2	...	1.0	.2	7.7
34...	375.5	31.0	22.1	176.22	32.3	78.5	5.8	4.0	2.2	.5	1.1	...	.1	.1	...	...	...	9.2	6.6	29.6
35...	51.3	...	25.9	38.04	28.8	83.1	1.7	6.2	8.2	4.3	.1	1.5	...	...	...	...	.7	.5	10.4	33.6
*36...	321.7	31.1	19.5	158.89	51.5	51.8	2.3	3.1	8.1	2.2	1.9	...	2.7	...	...	...	...	5.1	.5	25.9
37...	79.3	1.3	12.5	68.28	29.6	94.6	6.0	3.4	3.1	4.5	...	...	...	.3	...	...	...	3.6	1.3	22.2
38...	224.9	1.3	32.8	148.14	28.4	82.3	4.7	6.6	3.3	.5	...	3.3	...	1.2	.7	.7	1.4	3.6	8.3	34.3
39...	89.0	...	8.2	81.73	41.9	76.5	3.2	1.3	1.5	1.7	1.0	...	...	...	.4	...	...	...	1.8	10.9
40...	185.7	7.4	9.8	153.86	45.0	73.3	1.0	.3	1.7	2.4	...	...	...	...	...	...	...	1.4	1.6	8.4
41...	168.0	...	51.5	81.57	40.7	76.0	2.7	2.1	.5	.4	...	...	...	1.0	...	...	...	2.9	4.5	14.1
42...	417.0	.5	11.2	368.41	37.8	80.8	2.2	3.8	2.7	.1	.2	...	.2	.8	...	...	...	2.1	3.0	15.1
43...	230.0	1.1	24.9	170.16	37.3	71.7	7.2	14.7	.2	.1	1.9	...	...	...	...	...	...	1.7	...	25.8
44...	380.6	13.9	21.8	244.93	38.1	77.0	3.4	4.4	1.2	.9	.3	.3	.1	2.0	2.5	.1	.3	.4	2.5	18.4
45...	330.7	4.7	11.0	278.90	48.3	68.1	2.0	1.7	1.4	.7	...	...	...	...	...	...	...	2.5	.2	8.5
46...	232.4	1.6	7.4	211.60	47.3	71.0	.3	2.2	1.3	.4	...	...	...	...	...	...	...	.9	1.5	6.6
47...	100.5	2.9	24.4	79.61	36.8	77.5	3.4	5.5	4.3	.7	2.1	.1	.7	...	.3	...	1.0	2.4	.2	20.7
48...	160.0	6.7	17.7	120.92	34.6	82.8	11.0	3.9	.8	.5	...	...	.1	...	...	...	.3	.5	3.2	20.3
49...	86.2	8.7	.6	78.11	31.8	83.7	7.9	3.7	1.1	.4	...	...	...	...	...	1.3	...	.8	10.9	26.1
50...	292.1	15.8	11.1	213.66	33.5	87.8	1.1	2.3	2.2	.9	.9	1.7	1.7	...	...	...	...	3.8	3.5	18.2
51...	610.6	14.8	14.0	434.99	42.0	64.5	.9	1.2	10.2	2.4	3.2	...	.7	...	...	...	.5	.3	5.5	24.9
52...	505.0	12.0	13.5	376.25	37.0	81.0	1.7	2.6	2.1	1.1	.3	.6	...	...	1.3	...	...	1.4	5.6	16.7
53...	536.9	10.9	11.4	417.01	39.7	87.0	.4	1.2	.3	.8	.1	.2	.1	...	...	...	.3	.4	.3	4.1
54...	406.5	13.7	6.7	323.60	45.6	70.3	.9	.8	1.6	1.3	...	.3	...	...	...	...	...	1.5	4.6	11.0
55...	480.4	16.2	18.5	313.56	39.5	69.0	4.7	1.0	3.5	2.7	5.5	1.6	.7	.2	...	.3	...	.7	3.3	24.2
56...	387.5	24.8	19.8	214.50	31.3	85.2	2.5	2.2	1.7	.7	7.0	3.2	...	...	...	...	...	1.3	7.3	25.9
57...	574.5	26.1	20.1	309.16	35.6	90.1	1.0	1.7	.9	.8	1.4	...	.2	.1	.1	1.6	.3	1.1	1.7	10.9
58...	864.5	13.4	14.9	619.50	35.6	72.3	3.8	5.7	.3	.9	.6	.5	...	3.6	...	1.7	...	6.9	4.5	28.5
59...	1,088.0	8.9	29.2	673.61	35.5	80.2	3.5	.8	.7	1.8	5.8	.1	...	.3	.3	...	.7	3.5	3.4	20.9
60...	545.2	6.4	19.1	406.07	39.3	75.0	3.7	3.4	2.3	.9	1.7	.3	.2	.5	.1	.8	...	3.2	1.0	18.1
61...	150.5	6.9	14.2	138.37	38.2	77.3	1.2	3.4	2.2	.7	.2	1.2	...	...	...	...	...	4.1	4.8	17.8
62...	453.5	11.8	18.8	314.90	44.9	70.2	1.9	1.9	1.7	1.3	1.1	...	1.0	...	...	...	...	1.8	1.9	12.6
63...	153.4	13.7	2.2	120.02	40.3	72.1	.1	.1	.4	.3	...	...	...	...	...	...	.1	...	.9	1.9
64...	812.6	21.6	7.8	574.18	37.6	79.2	5.3	1.7	1.2	.3	3.7	...	...	...	.2	...	1.5	1.1	2.4	17.4
65...	394.2	41.7	.8	226.93	32.2	99.2	1.1	4.4	3.1	.6	1.0	.1	.1	...	...	...	...	.6	.3	11.3
66...	99.5	.4	3.9	95.20	47.5	72.0	1.8	.1	.3	1.1	...	...	...	...	...	...	...	.1	1.5	4.9
67...	558.3	13.4	25.6	340.74	39.7	72.1	5.2	3.1	.4	1.5	1.7	...	.1	...	...	...	...	5.4	3.3	20.7
68...	276.0	.3	13.5	237.92	46.2	63.3	5.6	5.2	1.4	1.0	1.1	1.1	...	...	...	...	...	...	3.4	18.8
69...	53.0	...	2.6	51.62	39.7	75.3	...	8.9	.7	.4	.6	.6	...	...	...	...	...	...	5.6	16.8
70...	267.8	4.3	4.6	243.98	48.3	62.2	1.2	4.4	3.0	.4	2.0	.8	2.3	...	...	...	...	.4	2.0	16.5
71...	638.6	6.7	21.4	459.20	45.7	70.6	1.3	1.7	.4	1.1	2.1	...	.9	...	...	...	...	1.5	1.3	10.3
72...	388.2	56.5	6.1	145.25	35.6	71.9	19.5	3.5	.5	1.5	2.8	...	...	...	...	...	...	.1	1.1	29.0
73...	612.8	2.0	16.2	501.43	45.6	72.9	.9	.9	.4	.7	1.3	...	.1	.3	...	...	.1	.8	2.1	7.6
74...	958.1	13.7	6.8	761.56	44.0	65.5	7.0	1.9	1.0	.4	2.3	.8	.9	...	...	...	...	1.6	1.5	18.3
75...	302.2	18.4	11.1	276.60	31.5	60.4	24.1	.3	1.5	1.1	5.5	.9	.4	1.1	...	...	...	...	...	...
76...	294.3	7.1	15.4	228.05	29.4	82.7	14.8	3.3	.8	.6	1.4	.3	...	4.6	...	1.9	...	2.0	2.9	32.6
77...	342.0	5.2	7.8	297.60	43.1	74.3	1.9	1.5	3.5	1.3	.3	.6	...	...	...	...	...	.3	1.7	11.1
Wtd.Av.	29,790.4	20.8	15.3	19,049.34	38.3	75.9	4.7	3.2	1.6	1.2	1.9	.4	.5	.5	.1	.2	.3	1.9	2.9	19.4

*Two mixers were operated in tandem on job 36 and the given cycle is the average time between batches when operating at full capacity.

Note: Major delays include all of that portion of the regular or normally available working hours during which the key producer was inactive in individual stops or shutdowns which exceeded 15 minutes in duration. Minor delays include all interruptions to the regular full-rate production of the key equipment which are less than 15 minutes in duration.

and its organization may only be able to supply a maximum of 40 botches per hour. In like manner, any of the other operations might be so equipped, organized or conducted as to restrict production to some lower limit. Thus the pump and pipe line may be unable to deliver water for more than, say, 40 batches per hour, or the subgrading crew may be unable to exceed this lower rate. Unless and until these deficiencies are remedied the full production rate of the key producer will never be attained.

Standing Trucks Earn No Profit for the Contractor. Beyond the Minimum Oversupply Necessary to Insure Continuous Mixer Operation, Additional Trucks are an Unnecessary Expense.

The essential fact here is that any of the subsidiary operations may establish the maximum attainable rate of production and thus this rate will always be lower than the possible maximum of the natural key producer, which in ordinary concrete paving work is the mixer. Furthermore, while it may occasionally prove economical to definitely design the organization and equipment for a maximum production rate somewhat below that attainable by the key producer this would be unusual. The handicap imposed on unit production costs by such an arrangement is so great that any production rate lower than that of the key producer can rarely be tolerated. The reason for this is simple. Except for the number of hauling units the amount of equipment required for the construction of a modern concrete paving job is practically independent of the rate of production. But the daily or hourly operating and ownership cost of this equipment, so long as it operates at all, is practically the same, regardless of whether production is high or low. Thus, not only the equipment for mixing, finishing, subgrading, batching, material handling, form setting, water supply and curing, together with the skilled labor required to operate this equipment, but also its hourly operating cost is essentially the same regardless of whether a mixer capable of producing 50 batches per hour is placed in an outfit capable of sustaining this maximum rate or placed in an outfit capable of attaining only 35 batches per hour. If the outfit is definitely organized to produce a maximum of only 35 batches per hour a few men can be dispensed with, but these are practically all common laborers connected with operations the unit cost of which tend to increase rather than decrease with successive reductions in the rate at which they are performed.

Thus the unit cost of preparing subgrade, setting forms, or finishing and curing the pavement, while usually considered as practically independent of the rate at which the work is performed so long as the rate is high enough to warrant the thorough organization of the work, are in fact considerably affected by the rate at which these operations are performed since all ordinary rates require the use of practically the same amount of mechanical equipment. Thus if the cost of preparing subgrade is 10 ct. per square yard when the rate of production is 50 batches or 225 sq. yd. per hour it may be at least 10 per cent higher when production falls to 35 batches or 158 sq. yd. per hour. In fact, numerous actual observations indicate that due to the better morale which almost invariably accompanies the well-managed, fast-moving job the unit cost for the higher production rate is even lower than would be inferred from the equipment the use of which is common to both jobs.

Management's Task Two-Fold

The task of the management is therefore twofold: first, to select a suitable and well-balanced equipment set-up and to develop and train an organization capable of utilizing the full possibilities of this equipment assembly; and, second, to so manage this assembled and manned outfit as to utilize and fully convert its potential production ability into the optimum number of square yards of completed pavement per working hour or day. This is no easy task as can be seen from a glance at Column 6 of Table I, where we find that the average rate of production on the various jobs actually ranged from 17.6 to 56.6 batches per working hour. The weighted average rate for all of the studies was 38.26 batches per working hour, which is 19.4 per cent below what the average equipment was capable of producing.

Efficient management of any concrete paving job therefore involves not only the proper selection of equipment and personnel, but also what is even more important, the proper coordination, direction and conduct of the various more or less independent operations. For no matter how fast the mixer nor how expert its operation, actual production cannot proceed faster or with more regularity than that with which the hauling units deliver the batches into the mixer skip. Nor does the necessity for managerial control end with the mixer and the operation of the hauling

units. This coordination must also extend to the preparation of the subgrade, setting the forms, placing the steel and joints, and spreading, finishing and curing the green concrete. Batches can be mixed no faster than permitted by the slowest of these operations.

Effect of Management on Minor Time Losses

In concrete paving work on any given job the deviations from the ideal rate of produciton appear mainly as minor time losses or operating delays to the mixer. The extent of these minor delays or interruptions to continuous operation during working hours can readily be measured with a stop-watch and made a matter of record. This was done on the 77 jobs included in this study. A comparison of such of these minor time losses or delays as are amenable to control by the management then gives us a means for evaluating the relative efficiency of the management on different jobs. But since working conditions and specifications on any two concrete paving jobs are never exactly the same, this measure is admittedly not always precise, but it is apparently definite enough to distinguish readily between good, average and poor management. This is as far as the present study has attempted to differentiate between the various grades of management and in noting the effect of good and poor management on production rates.

To illustrate more particularly the extent to which the management affects production, the 12 jobs having the lowest minor time losses and the 11 jobs having the highest minor time losses of the 77 jobs included in this study have been compiled in Table II. This table reveals several interesting facts. While the average time lost in minor delays for all of the 77 jobs, as shown in Table I, was 19.4 per cent, the average time lost in such minor delays on the 12 low-time-loss jobs was only 6 per cent of the actual working time. On the other hand, the actual working time lost in such minor delays on the 11 high-time-loss jobs reached an average of 37.7 per cent. The highest loss on any individual job was 57 per cent of the actual working time. The lowest was 1.9 per cent. Production on the 12 low-time-loss jobs was at the high average rate of 48.5 batches per hour our while on the 11 high-time-loss jobs the average rate of production was only 27.8 batches per working hour.

A part of this 42.7 per cent decrease in the production rate of the high-time-loss jobs is of course due to the 15.7 per cent longer average mixer cycle under these jobs operated. The main difference between the average production rates of the two groups of jobs, however, is due to the fact that whereas the first group utilized about 3,400 seconds out of every working hour in useful production the second group utilized only 2,300 seconds. The mixers on the first group were unproductive on an average of only about

TABLE II—COMPARISON OF PRODUCTION RATES AND MIXER CYCLES BETWEEN JOBS SHOWING VERY SMALL MINOR TIME LOSSES AND JOBS SHOWING VERY LARGE MINOR TIME LOSSES

Jobs With Small Time Losses				Jobs With Large Time Losses			
Job No.	Average Minor Time Loss in Per Cent	Average Production Batches Per Hour	Average Mixer Cycle in Seconds	Job No.	Average Minor Time Loss in Per Cent	Average Production Batches Per Hour	Average Mixer Cycle in Seconds
11	5.0	47.1	72.7	2	37.6	32.5	68.9
18	7.5	44.1	75.6	7	43.7	23.3	87.2
31	3.9	56.5	61.3	8	33.0	30.8	78.3
32	5.6	56.6	60.1	14	32.0	28.0	87.1
33	7.7	54.9	60.5	25	32.3	28.9	84.2
40	8.4	45.0	73.3	26	57.0	17.6	88.1
45	8.5	48.3	68.1	28	39.3	26.5	85.9
46	6.6	47.3	71.0	35	33.6	28.8	83.1
53	4.1	39.7	87.0	38	34.3	28.4	82.3
63	1.9	49.3	72.1	75	39.3	31.5	69.4
66	4.9	47.5	72.0	76	32.6	29.4	82.7
73	7.6	45.6	72.9				
Straight averages	6.0	48.5	70.5		37.7	27.8	81.6

The preparation of the Subgrade Is the Second Most Prolific Source of Low Production on Most Poorly Managed Jobs. On the Well Managed Jobs Such Interference Is Rare.

200 seconds during each working hour while the mixers on the second group were unproductive an average of 1,300 seconds or more than one-third of each working hour. It must also be remembered that all these delays were of a minor nature, 15 minutes or less in duration, so that the cost of both labor and equipment operation was for all practical purposes the same as if production had proceeded continuously at maximum capacity.

The Function of the Materials Yard is to Receive the Materials and Load Them Out in Batches of Definite Size and Proportion with the Least Possible Interference to the Continuous Orderly Movement of the Hauling Units. A Yard Layout Which Permits a Straight Drive Through the Bins Is Therefore a Real Asset.

How Managerial Control Affects Time Losses

Table III illustrates more fully the extent to which each of these various time losses are amenable to managerial control. The first and most striking differences are those connected with the supply and operation of the hauling equipment. Here the average loss of the well-managed jobs was only 2 per cent as compared with an average loss of 16.4 per cent of the actual working time on the poorly managed job. The average time loss on the poorly managed jobs was therefore more than 8 times the average time loss on the 12 well-managed jobs, and nearly 4 times the average loss on all the jobs. Thus the well-managed job number 63 lost a total of only 0.2 per cent of its working time on the supply or operation of the hauling equipment as against a 30.7 per cent from these causes on job number 26.

TABLE III—CAUSE AND AMOUNT OF AVERAGE MINOR TIME LOSSES ON HIGH AND LOW TIME LOSS GROUPS, AND ON ALL JOBS

Cause	Low Time Loss Group Per Cent	High Time Loss Group Per Cent	All 77 Jobs Per Cent
Hauling equipment:			
Supply	1.2	10.4	4.7
Operation	.8	6.0	3.2
Mixer:			
Operator	.8	2.8	1.6
Mechanical	1.1	1.9	1.2
Lack of subgrade	.2	4.2	1.9
Placing steel	..	1.1	.4
Setting joints	..	.8	.5
Finishing	..	1.4	.5
Materials yard:			
Lack of materials	..	...	.1
Crane and batcher	.3	.2	.2
Handling cement	..	1.1	.3
Water supply and line	.8	2.2	1.9
Miscellaneous	.8	5.6	2.9
Averages	6.0	37.7	19.4

Lack of prepared subgrade was another prolific source of lost time on the poorly managed jobs amounting to an average of 2.8 per cent on these as compared to an average of 0.2 per cent on the 12 well-managed jobs. The placing of the steel, setting the joints, handling the cement, finishing the pavement and providing the water also contributed correspondingly at a much greater rate to the minor time losses on the poroly managed jobs, or 6.6 per cent as against only 0.8 per cent for the well-managed jobs. The mixer operators on the poorly managed job were responsible for a loss of 2.8 per cent of the working time as against only 0.8 per cent for mixer operators on the well-managed jobs. The mixer itself, however, operated nearly as well on all kinds of jobs. Thus while trouble or difficulties with the operation of the mixer itself or its mechanism caused a loss of 1.1 per cent of the working time on the 12 best managed jobs the loss from the same source was only 1.9 per cent on the 11 poorly managed jobs and an average of 1.2 per cent on all the 77 jobs. Even breakdowns and major mechanical difficulties of all kinds on the part of the mixer contributed only an average of 1.2 per cent to the major time losses for all the jobs. This speaks volumes for the sturdiness and dependability of the modern paver.

It is not contended, however, that this difference in the production rates of the two groups of pavers was all due to management. An undetermined amount was no doubt due to conditions entirely independent of management, such as weather and working condition, traffic, and hauling difficulties and labor supply, since no two jobs are ever exactly comparable as to all these conditions. But such features as the selection of the proper equipment, development of efficient and effective methods of operation, the proper coordination and synchronization of the various operations and of inspiring the organization and infusing it with vim and vigor are all essentially functions of the management. How effectively this was accomplished is clearly reflected in the relative proportion of the actual working time which was lost in minor delays. Futheromre the ability and skill with which this management was directed becomes evident in the relative magnitude of the actual production rates. For it is only as the minor time losses are reduced that production rates can be increased. Consequently the net or final effect of managerial ability is invariably reflected in an increased rate of production.

High Grade Management Has Low Minor Time Losses

And while inspection and specification restrictions, economic requirements and local field conditions always impose many limitations as to how and in what way management may act they seldom either abrogate or usurp any of its real function. They serve rather simply to limit or circumscribe the scope within which the functions of management may be utilized effectively. In concrete paving work, where such limitations are unnecessarily numerous, the question as to whether a certain result is due to management or to some other cause is therefore often difficult to determine. This much, however, is clear: high grade management is almost invariably associated with a relatively low minor time loss, while low grade or poor job management almost equally invariably shows a relatively high time loss from minor delays. Furthermore, for at all comparable mixing times and working requirements production rates invariably increase as the time losses from minor delays decrease.

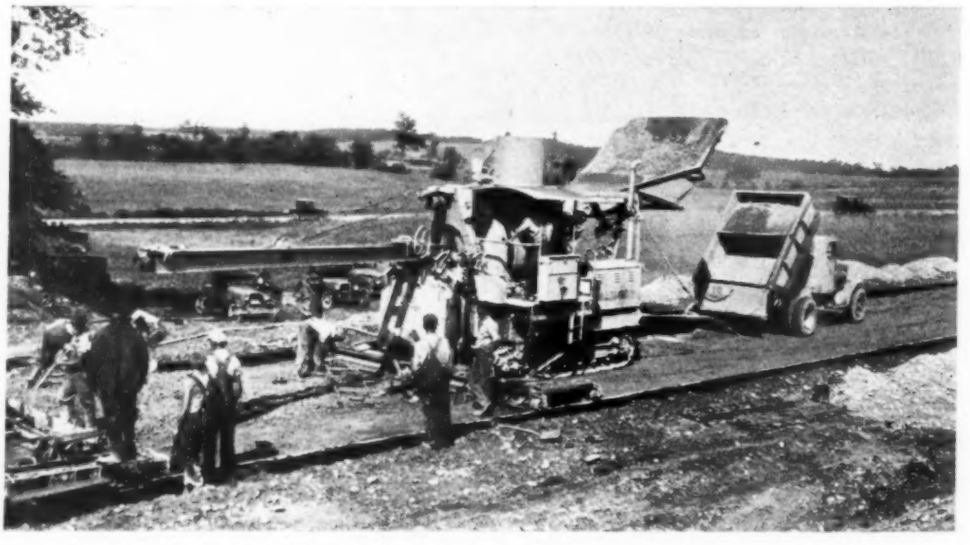
It is only natural that this should be so. The first and most obvious point for management to attack in any attempt to increase production rates is, of course, the elimination or reduction of repetitive time losses or delays to the key producer. As these are reduced the time so gained can usually be largely or entirely utilized in securing additional production. Sometimes, however, certain changes or additions must be made before the time so gained can be converted into actual production. Thus if, for example, it is found that a mixer working on a regular cycle of 72 seconds is delayed an average of 18 seconds between each batch by the final preparation of the subgrade and in placing the reinforcing steel than the effective cycle is really 90 seconds and actual production only 40 batches per hour instead of the possible 50. But the elimination is frequently of little practical value until all of the subsidiary operations have been coordinated to support the new rate. This is the function of management, and the more able the management the more nearly do we find that the relation of the various operations generally approach perfect coordination.

Relative Importance of Various Kinds of Time Losses

In considering the relative magnitude or importance of the various kind of time losses met with on these 77 jobs we find first that an average of 20.8 per cent of the total time which was available to the contractor for job operations was lost because of unfavorable weather conditions, mostly in the form of rain and the natural effect of rain—wet subgrade. All other major time losses as shown in Tables IV and V amounted to an average of 15.3 per cent, making a total loss of 36.1 per cent of the available working time in major delays

TABLE IV—MAJOR TIME LOSSES ON THE TWO GROUPS OF JOBS HAVING THE LOWEST AND THE HIGHEST MINOR TIME LOSSES, IN PER CENT OF TOTAL AVAILABLE WORKING TIME

12 Low Minor Time Loss Jobs			11 High Minor Time Loss Jobs		
Job No.	Due to Weather	Due to All Other Causes	Job No.	Due to Weather	Due to All Other Causes
11	14.3	18.3	2	20.3	22.5
18	49.7	5.3	7	13.9	31.4
31	12.5	7.2	8	15.1	25.7
32	12.5	8.0	14	48.1	11.6
33	4.1	8.8	25	.4	13.0
40	7.4	9.8	26	68.4	6.8
45	4.7	11.0	28	27.9	13.8
46	1.6	7.4	35	...	25.9
53	10.9	11.4	38	1.3	32.8
63	13.7	2.2	75	18.4	11.1
66	.4	3.9	76	7.1	15.4
73	2.0	16.2			
Averages ...	11.2	9.1		20.1	19.1
Averages for all 77 jobs				20.8	15.3



The Batch Hauling Is Usually the Operation Management Finds Most Difficult to Co-ordinate Fully with the Demands of the Mixer and at the Same Time Secure Full Efficiency From the Hauling Units.

of these subgrade delays will not of itself bring about an increase in production unless the hauling equipment is also increased or speeded up sufficiently to match the faster rate. Attention must also be given to the finishing and curing to see that these are also carried on at the faster rate. The previous rate of preparing the rough subgrade and setting the forms must also be stepped up to match the daily average of the new rate. Thus the mere elimination of a time loss at one point for the average concrete paving job. But since 19.4 per cent of the actual working time, or the time remaining after deducting all the 36.1 per cent of the available time which was lost in major delays, we find that the average contractor managed to operate his paving plant at full capacity only during 51.5 per cent of his normally available working hours. A total of 48.5 per cent of the available hours were completely lost so far as actual production was concerned, 36.1 per

TABLE V—CAUSE AND AMOUNT OF AVERAGE MAJOR TIME LOSSES

Average Percentage of Normally Available Working Hours Lost in Delays of More Than 15 Minutes in Duration (Averages from 77 concrete paving jobs)

Cause	Avg. Major Time Loss in Per Cent of Total Available Working Time
Rain	9.2
Wet subgrade	8.6
Cold weather	3.0
Hauling equipment	.5
Moving mixer or batching plant	3.5
Mixer trouble	1.2
Lack of subgrade	2.2
Lack of materials	1.5
Crane and batcher	1.2
Finishing	.6
Setting forms	.2
Water supply	1.3
Miscellaneous	3.1
Total	36.1

cent in major delays and an additional 12.4 per cent in minor delays. Most of the major time loss, however, was in quarters, half and full days during which practically all operations were suspended. The hourly or daily cost to the contractor of this type of time loss was therefore in general much less than those due to the minor delays when all operations were in more or less active progress.

Most of the major time losses are obviously but little amenable to the control of the management. Occasionally we find, however, where a little foresight and care on the part of the management has produced an appreciable decrease. Thus the opening of a few shoulder drains before an oncoming rain sometimes materially reduces the time which must be spent in waiting for the subgrade to dry sufficiently for the resumption of paving operations. A little extra attention to more regular and thorough inspection of the mechanical equipment not infrequently discovers incipent evidence of a forthcoming breakdown in time to permit repairs or replacements to be made without delaying production or at least to order and have on hand the necessary parts. But these are only isolated illustrations. Just as to how much the grade of management actually affected the amount of the major time losses on these 77 jobs the data give only circumstantial evidence. Thus while, as shown in Table IV, the average of the major time losses for all causes other than those arising from the weather consumed only 9.1 per cent of the total available time on the 12 high-production jobs as compared with 19.1 per cent on the 11 low-production jobs, the weather losses, over which management admittedly has but little control, were in nearly the same proportion or 11.2 and 20.1 per cent, respectively. This compares with an average loss of 20.8 per cent from causes due to the weather and with 15.3 per cent from all other causes for all of the 77 jobs. But neither all the highest nor all the lowest major time losses of either class fall within this high and low minor time loss grouping nor within the highest and lowest production rates. Thus while superior management evidently does have a tendency to be associated with less than average major time losses this evidence is not so clear and definite as it is for the minor time losses.

It is therefore extremely essential that management realize the importance of reducing or eliminating the minor time losses and of maintaining production at or as near as possible to the maximum rate of which the outfit is capable. In general this should be the rate of the mixer, and the capacity of the supporting equipment and operating personnel should be fully capable of sustaining this rate. How nearly and how consistently this maximum production rate is approached in actual operation then depends on the ability and ingenuity of the management.

Synchronization of Subsidiary Operations

Here it is well to recognize the relative degree of synchronization required for the different subsidiary or supporting operations. Of these the most important and the most difficult to completely synchronize is the operation of the hauling units as illustrated by the time losses shown in table 3. Here practically no storage is possible without the addition of hauling units over and above those actually required for the most economical transportation of the batches. Consequently every effort must be made to maintain the steady, uninterrupted operation of the batch trucks, through the materials yard, on the road and at the mixer. The synchronization must constantly and from day to day be the closest possible. This is equally true for whatever rate of production the outfit may be designed. Eternal vigilance is equally necessary to maintain this designed rate no matter what it may be and every decrease below this rate means a corresponding increase in the unit operating costs. There is therefore rarely any merit in equipping and organizing the concrete paving outfit for a production rate materially below that fixed by the mixer.

In such work as preparing subgrade and setting forms considerable storage or leeway is generally possible and the rate of operation may be gauged more nearly to the average daily rate of the mixer. The preparation should therefore (from the start) be kept sufficiently ahead of the mixer to be able to absorb all hour to hour variations in mixer production without any delays to either the mixer or to the hauling units.

Special attention must, however, always be given to the batch hauling. Table I reveals that of all the 77 jobs not one succeeded in operating without incurring some time losses from this source. Eternal vigilance is therefore necessary in order to keep these losses within reasonable bounds without resorting to the use of an entirely uneconomical number of hauling vehicles. In batch hauling no storage is possible, except in the extremely expensive form of keeping loaded vehicles waiting at the mixer, and all shortcomings in the operation of the hauling units are therefore immediately reflected in the operation of the mixer. If a truck fails to arrive on time or to dump its batch promptly the production of the following batch is delayed by exactly that amount. These as well as all other delays can all be observed, timed, and their amount, cause and effect on production recorded. This must be accepted by the job management as an essential routine duty. In no other way can such precise knowledge be secured of the way each operation is contributing its part toward maintaining the desired rate of production. But the chief purpose of management is to maintain production and this can only be achieved through the prevention of these minor time losses. The amount of these minor times losses may therefore well be used as a measure of the degree of success with which the management is functioning on any given job. On the well-managed job these minor time losses will be relatively low; on the poorly managed job they will invariably be high.

ALL INDICATIONS POINT TO THE 1938 A. R. B. A. ROAD SHOW AND CONVENTION AS THE ONE THAT IS GOING TO BE THE BIGGEST AND BEST IN THE HISTORY OF THE ORGANIZATION.

ROAD BUILDERS

JUNE, 1937 **AMERICAN ROAD BUILDERS'**

MAY MEETING IS *Down the Road*

By C. M. UPHAM

Engineer-Director,
American Road Builders' Association

Need for Education

No one can say that a senator or a congressman lacks vision. It takes a far-sighted individual to help make laws that will be of future benefit to the most number of people.

By the time this gets into print, the House of Representatives of the 75th Congress of the United States will have been called upon, by means of a "roll-call" vote, to either reaffirm their previous adoption of the Cartwright Highway Amendment to the Federal relief bill, or to reject it entirely.

There is no reasonable doubt regarding the need of this particular type of legislation, for its need has already been accentuated by two rather astounding predictions for the year 1937. If highway traffic-accident fatalities and disabilities continue to mount through the remainder of the year with the tremendous rapidity with which they have increased during the first part of 1937 over the same period of last year, and figures compiled to date show a 26 per cent increase, then the story that will be told at the end of the year will concern itself with the horrible statement that more than 40,000 of our fellow men have been slaughtered in avoidable highway accidents. Second, and no less in its importance, is the prediction by automotive industry experts that 1937 will outrank all other years in the history of the industry as a peak production year.

If the House of Representatives has by this time rejected, or cut to an inadequate sum the specifications of the Cartwright Highway Amendment, then these same honorable gentlemen have failed to realize the urgent need for building more good and safe roads.

Then, as has been said above, no one can question the vision of these men and no one can discredit their intelligence. It can be said, however, that they have not been educated to the road needs of the sections of the country that they represent in Congress.

If we have been inarticulate in our efforts to explain the reasons why more money should be provided for the building of modern highways, then we must hasten to clearly define ourselves and the far-reaching benefits to be obtained from our efforts. We must work in concert to educate the men and women who make the laws of our various states and of our nation to a point where they will know exactly what has to be done to rebuild our antiquated roads to take care of the demands of streamlined travel and what must be done to build safety features into our new roads that will diminish the great disgrace that is the nation's deplorable number of unnecessary highway-accident fatalities and disabilities.

If anyone of us can call upon our particular legislator and point out to him the necessity of rebuilding a certain stretch of road in, shall we say, the northwest portion of the section of the state that he represents, or convince him of the necessity of constructing a completely new stretch of road, and we bring with us adequate proof to make him understand and appreciate that need, then we have been teachers of a truth and not hearers only.

Yes, there is a need for education, there is a need for convincing those who provide for the expenditure of money on projects of benefit to the public that the most useful of public works is the building of roads, and the projects attendant thereon, and that all highway construction can best and most capably be handled by the United States Bureau of Public Roads through the various state highway departments, making use of the contract system.

The 35th annual May meeting of the American Road Builders' Association, which closed its diversified three-day program at the Willard Hotel in Washington, Friday, May 28, 1937, was pronounced by the three hundred members who attended its sessions as the best and most interesting in the history of the organization.

The initial business meeting Wednesday morning, May 26, was addressed by Colonel Willard T. Chevalier of New York, president of the association, and Thomas H. MacDonald, chief, U. S. Bureau of Public Roads.

Permanent Road Planning Needed

Mr. MacDonald declared diversion has been suffered in the past because of an inadequate presentation of the needs of the nation's highways to the various state legislatures. The establishment of a permanent road-planning commission in every state so that state authorities can be acquainted with the need of providing money for more good and safe roads was advocated by Mr. MacDonald, who added that many of the main highways of the country should be rebuilt.

"We feel that it is sound to have the state highway department, with the cooperation of the Bureau, gathering data and making use of it as a foundation on which to base the plans of road improvement, but that this planning and information must be kept constantly up to date so that it can be had every time the legislators meet. Every time that the highway commission makes the program for the year's work, the information on which that program is based should be fresh and up to date and weighed in a relative way to fix priority of improvement.

"I think that we can say that, if this planning survey is followed up properly by a continuous study in the future, it is an intelligent attack on the road improvement problem and we will be able to present to the state legislators each year the necessities in no uncertain terms and we will certainly be able to do this in a degree that we have never been able to approach in the past."

Resume'

"AS LONG AS THE ROADS OF THE NATION ARE USED BY MORE THAN 24,000,000 AUTOMOBILES AND TRUCKS, CONSTRUCTION AND IMPROVEMENT OF ROADS WILL BE OF MAJOR IMPORTANCE."
—FRANKLIN D. ROOSEVELT

ASSOCIATION—WASHINGTON JUNE, 1937

A HUGE SUCCESS

Boykin Discusses Diversion

The gas-tax diversion meeting, Thursday morning, May 27, was a well attended and vitally interesting session of the annual meeting. L. E. Boykin, chief, division of laws and contracts, Bureau of Public Roads, Washington, made an instructive address before the gathering in which he said, "There is a point that I want to emphasize that becomes rather important and that is what revenues must go into the road fund for a state to be considered not guilty of diversion. For instance, there are a number of what might be called special revenues that are not really taxes on the motor vehicle or the motor vehicle user, or operator, and which have no relation to the use of a motorcar on the highway, other than indirectly.

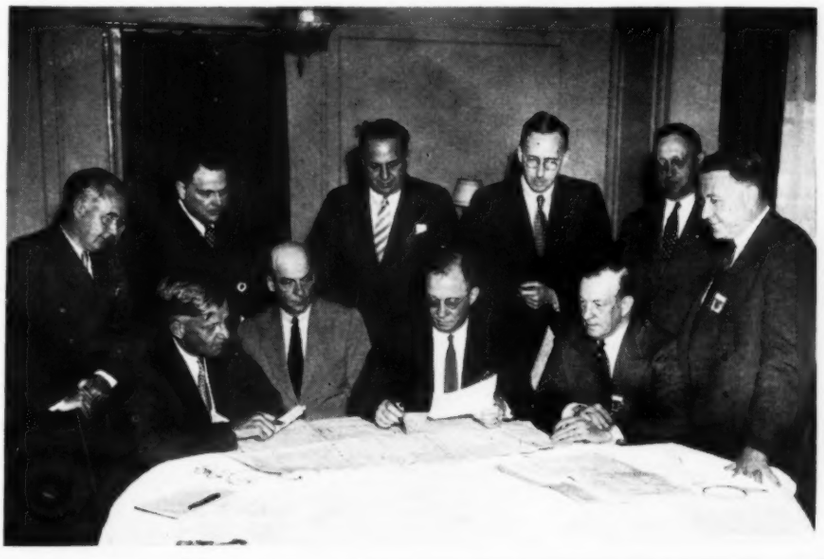
"For instance, take fines and forfeitures. They can't be called taxes and yet, in some states, they go into the highway fund, just the same as do the license taxes on motor vehicles, or the taxes on gasoline. Where this is true, even though they have been going into highway purposes before, if this particular type of fund is taken out, we can't say that diversion has been practiced within the meaning of Section 12 of the Hayden-Cartwright Act. Then you take the use of gasoline in a motorboat, or in an airplane, or in farm machinery, or in a dry-cleaning establishment; none of these would be diversion within the provisions of the law.

"We have this situation. Congress appropriates a big sum of money to be proportioned among the various states on a stipulated basis. Each state is entitled to a certain sum of money subject to its compliance with the conditions that have been set up by Congress. By the provisions of Section 12 of the Hayden-Cartwright Road Act of 1934, Congress added another condition which these states have to meet, and is just a condition that it attached to a grant, or a gift. If they don't meet these conditions, why, then, they don't get the grant, or the donation, and that is all there is to it."

Tabler Heads Safety Meeting

Dr. H. E. Tabler, chairman of the State Roads Commission of Maryland and chairman of the Committee on Safe Highways of the American Road Builders' Association, pointed out that fatalities due to traffic accidents have increased by 9.6 per cent already this year in the urban sections of our nation with an increase of approximately 26 per cent on the open road.

In urging the association to secure public support for road improvements and engi- manufactured on wholesale scale and installed at a minimum cost, flexible guard rails that absorb just enough of the impact without throwing the motor vehicle across the road and the cloverleaf highway intersections were among subjects considered by the Committee on Safe Highways.



A. R. B. A. JOINT EXHIBIT COMMITTEE

Seated, left to right, Lion Gardiner, Vice-President, Jaeger Machine Company, Columbus, Ohio; C. W. Brown, Chief Engineer, State Highway Department, Jefferson City, Mo.; Williard T. Chevalier, Vice-President, McGraw-Hill Publishing Co., New York City; William P. MacDonald, President, William P. McDonald Construction Co., Flushing, N. Y. Standing, left to right, B. F. Devine, Sales Manager, Construction Equipment Division, Chain Belt Co., Milwaukee, Wis.; William M. Parrish, Industrial Sales Executive, International Harvester Co., Chicago, Ill.; C. D. McPherson, Gar Wood Industries, Inc., Detroit, Mich.; Chauncy B. Smythe, Vice-President Thew Shovel Co., Lorain, Ohio; George F. Schlesinger, Chief Engineer and Managing Director, National Paving Brick Association, Washington, D. C., and Charles M. Upham, Engineer-Director, American Road Builders' Association, Washington, D. C.

Contractors' Session a Highlight

The meeting of the Highway Contractors' Division proved to be a highlight on the three-day calendar. R. Gordon Wagenet, director, Bureau of Unemployment Compensation, Social Security Board, Washington, gave an excellent and comprehensive explanation concerning the effects of the Social Security Act on the highway industry. S. S. Riddle, Pennsylvania State Chamber of Commerce, Harrisburg, also talked on the Social Security Act and did an equally fine job in clearly presenting this subject to the gathering.

OBSERVATIONS BY THE WAY

By A. PUDDLE JUMPER

¶ Residents of Skowhegan, Maine, appreciate the rebuilding and stiffening of the suspension foot bridge across South Channel. The clear span between towers is 220 feet; including the short approaches, the length is 252 feet. The new Williamsport cables were erected by Contractor Marble after designs of Mr. E. E. Greenwood, C.E., of Skowhegan. The new bridge is higher than the high water of last year. It's a good looking structure.

New Suspension Bridge, Pride of Skowhegan, Me. Photo courtesy, S. M. Rounds, Editor, Skowhegan Independent Reporter

¶ Indiana now is experimenting with highway lighting. They have recently put into operation an experimental mile on U. S. 20 at Michigan City, Indiana.

• •

¶ Three guesses—what is this? Best and Caterpillar people not permitted to guess; they know the answer.

• •

¶ In one sense, the rules, regulations and specifications of the U. S. Bureau of Public Roads represents a Highway Code. In case anyone doubts the necessity of maintaining a fairly large research division of the bureau let him realize the importance of keeping a code abreast of the developments in the art. Rules which have become outgrown by the highway field rapidly become unenforceable. Traffic regulations illustrates a case in point. If a code is to be kept abreast of development of an art, engineering research becomes a necessity.

• •

¶ Knife attached to disc of Austin-Western elevating grader on Stanley Jaicks' job. (The West Counties Construction Co., Elmhurst, Ill.)

Cuts lumps and ribbon clay and prevents binding on belt of grader.

• •

¶ "That's my baby," says Ed Floring, operator of Austin-Western elevating grader on job on Roosevelt Rd. and Illinois 54 for West Counties Construction Co., Elmhurst, Ill. Note the knife blade bolted to the face of the disc for cutting up lumps and ribbon clay.

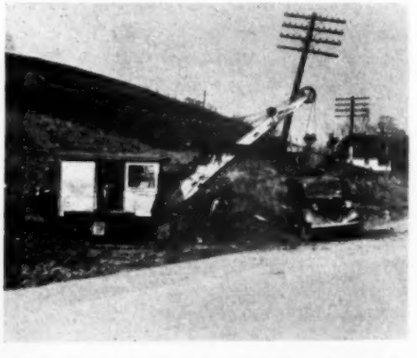
• •

¶ East of Wheeling, W. Va., a few miles, U. S. 40, was widened to four lanes. The hillside cut was held by a new concrete retaining wall. Wet

weather this spring caused sliding and a hundred or so feet of this wall was pushed out.

• •

¶ Removing slide where new retaining wall was pushed out on U. S.



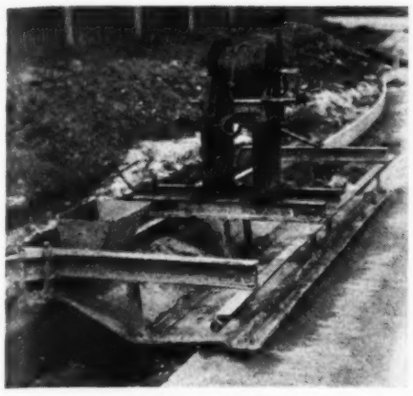
40, a few miles east of Wheeling, W. Va.

• •

¶ I heard complaints in South Carolina about their low vehicle tax. The tax is so low that old junk Model T's and antiquated models of other cars only pay about $2.00 per year for license plates. You know it at night when you are surprised around a curve or over a knoll as a jalloppy looms up in front of you, stalled on the roadway. I know!

• •

Texas Highway sign: "This is God's country. Don't drive like hell."



¶ Mule or strike-off for forming integral lip curb with widening of concrete pavement. Made by men of West Counties Construction Co., Elmhurst, Ill. Cable winch line hooks to form ahead. Mule pulled forward by cranking on winch. Finisher follows the mule.

• •

¶ There is a route over the mountains in Virginia on U. S. 60 where looking down the slope you can see three sections you just traveled. It's the first mountain west of Long Mountain named Blue Ridge Mountain.

• •

¶ Black top surface treated roads in the Ohio River flood area on Route U. S. 52 are worse for the wear. Pot-holing and alligatored spots are many.

• •

¶ Another thing I noticed on this road southeast of Cincinnati to Huntington, W. Va., was the slides on

side hill cut and fill, especially where the fill was 15 feet high or over.

• •

¶ One has to admire the courage displayed by those people whose homes were wrecked in the Ohio River flood zone when one sees them, young and old, industriously reconstructing what the flood left.

• •

¶ Virginia has done some nice work on Route 60. More power to you, Virginia, for more of the same thing.

• •

¶ I can't leave West Virginia without a word of commendation on the nice road from Huntington to the gates of Charleston. In 10 years the road east of Charleston will probably be as good—I hope.

• •

¶ I wonder if our state highway traffic surveys aren't going to be somewhat misleading as to pedestrian traffic? Counts are made at intersections and where a few stores or filling stations are near the intersection the pedestrian traffic count will not show a true picture.

¶ Spreading calcium chloride for dust settlement on U. S. 40 just west of Columbus, Ohio. This particular operation was a waste of public funds. Rain was predicted and fell within five minutes after this

picture was taken. Later on in the afternoon heavy downpours could do nothing but wash all the chloride into the side ditch.

• •

¶ Trailer coaches, specially designed with upper and lower berths, are being adopted by the Ohio State Highway Department for living quarters of road construction crews.

¶ Last week I saw a good thing south of Shaker Heights, Ohio. A police car escorted a school bus. Most all of the houses were on the opposite side of the road from the direction the bus was going, so the police car would pull across the opposing lane and block traffic.

• •

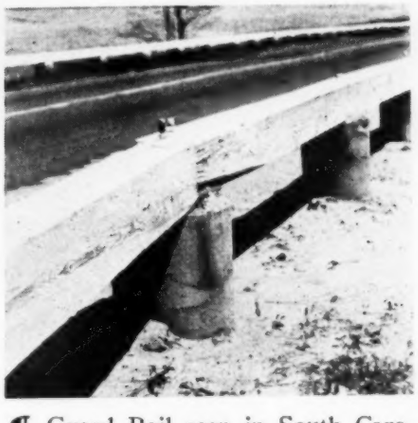
¶ *It Pays.* 'Tis sad but true that many men still believe that advertising is but a necessary evil—even after countless really successful business executives have proven their faith in advertising to be 100% correct.—*Elbee Tattler.*

¶ Old covered wooden bridge and three spans of spindly, rusty high truss bridge just north of Cheraw, S. C., on U. S. Route 1. I imagine they'll be replaced soon by new bridge on relocation of road.

¶ Getting out of Huntington, W. Va., going east on U. S. 60, was like chasing around the edge of a piece of a jigsaw puzzle.

• •

¶ One thing I think we will all admire is the design of steel bridges in West Virginia. Just a look at the bridge as you approach fills you with confidence. The bridges look sturdy and solid, like they would carry a couple of mountain locomotives.



¶ Guard Rail seen in South Carolina on U. S. Route 1.

Code of Highway Lighting

A CODE of street lighting was formulated by the Committee on Street Lighting of the Illuminating Engineering Society in 1929 and was first put into printed form in that year. It has since been revised, the last edition being published in 1935. From the start the code included sections dealing with highway lighting. Highway lighting, however, differs in so many respects from street lighting that in 1935 it was found expedient to prepare a separate code on highway lighting. Accordingly at the 30th Annual Convention of the Illuminating Engineering Society, the Committee on Street and Highway Lighting presented its report containing the following code, which is reprinted here from the Transactions of the Illuminating Engineering Society, Vol. XXXII, No. 2, February, 1937.

CODE OF HIGHWAY LIGHTING

This Code applies to highways which are defined as traffic ways which have not more than four intersections per mile and on which there is little pedestrian traffic. Traffic ways which do not fall within this definition are to be considered as urban thoroughfares and lighted in accordance with the Code of Street Lighting.

1. DEFINITIONS

A *luminaire* is a complete lighting device consisting of a light source, together with its direct appurtenances, such as globe, reflector, refractor, housing and such support as is integral with the housing. . . . The pole, post or bracket is not considered a part of the luminaire.

A *lighting unit* consists of the assembly of pole or post with bracket and luminaire.

Spacing is defined as the distance in feet between two successive lighting units measured along the center line of a roadway.

Mounting Height is the perpendicular distance between grade and the center of the light source in the luminaire.

Lumen is the unit of light flux in terms of which the output of light sources is expressed.

Foot-candle is the unit of illumination and is the illumination upon a surface which receives from all light-sources, directly or by reflection, one lumen per square foot.

Candle is the unit of light intensity. At a distance of one foot, a candle produces one foot-candle (equivalent to one lumen per square foot) upon a surface normal to the beam.

Brightness may be expressed in foot-lamberts. A foot-lambert is a unit of brightness equal to the average brightness of any surface emitting or reflecting light at the rate of one lumen per square foot. The average brightness of any reflecting surface in foot-lamberts is therefore the product of the illumination in foot-candles by the reflection factor of the surface. (The reflection factor, and hence the brightness, of any surface containing an element of specularity is affected by the angle of incidence of the light and the angle from which the surface is viewed.)

2. CLASSIFICATION OF HIGHWAYS

Highways may be classified as follows:

A. Highways bearing two-way traffic.[1]
   (1) Two lanes of traffic.
   (2) Three lanes of traffic.
   (3) Four lanes of traffic.

   There are so few five and six-lane highways, or wider, that the Committee feels these should be treated specifically rather than generally in the Code.

B. Highways separated by divisional islands, with traffic in opposite directions.
   (1) Four lanes of traffic.
   (2) Six lanes of traffic.
   (3) Eight lanes of traffic.

   Highways having islands 15 feet or more in width for separating opposite-bound traffic are to be regarded as two highways.

C. Other locations requiring special treatment.
   (1) Traffic circles.
   (2) Grade separations.
   (3) Cloverleaves.
   (4) Underpasses.
   (5) Bridges, viaducts, overpasses.
   (6) Intersections.
   (7) Highway through municipalities at grade.

Highways differ in importance, ranging from lightly traveled to heavily traveled routes. In determining the amount of lighting to be provided, the following facts should be considered:

(a) The night accident experience.
(b) The amount of traffic moving over the highway for an average 24-hour day and the peak traffic in any one hour.
(c) Type and speed of vehicular traffic.
(d) Contour and width of road, and availability of emergency parking area adjacent to the traveled portion.
(e) Light reeflcting qualities of the pavement—reflection factor and degree of specularity.

3. FUNDAMENTALS

Visibility

On highways the principal visibility requirement is tor discernment of objects on or immediately adjacent to the highway. When observed in the light of headlamp beams, objects are seen by reason of light reflected toward the driver. They are then visible in proportion as light reflection from their surfaces is good, or they may be visible because they are materially darker, or lighter than the more distant pavement as lighted by the headlamp beams. When seen against the pavement illuminated by approaching headlamps, they appear as silhouettes.

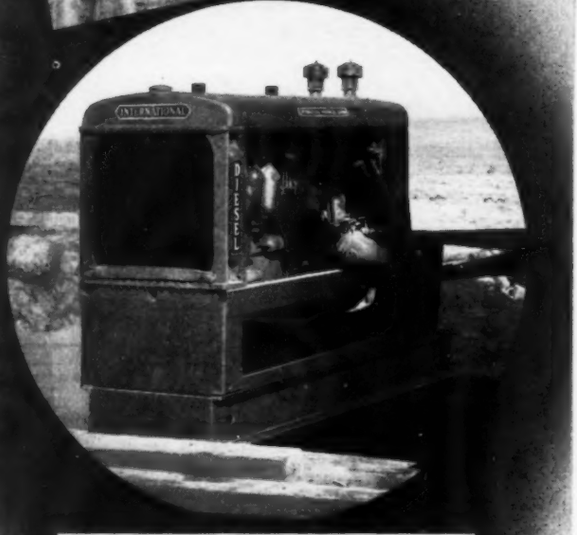
With fixed highway lighting, visibility through light reflected from objects may sometimes prevail but for the most part objects are discerned as outlines contrasting with the pavement beyond, which under fixed lighting, is generally brighter than the object observed. So that under these circumstances objects appear as silhouettes.

Thus, in order that silhouetting may be effective, it is important that the highway surface be rendered bright. This may be accomplished with a relatively small amount of fixed lighting in the case of light-colored pavement but much more light is required if the surface be of dark and low light reflecting quality.

[1] Two-way traffic means that there is traffic in both directions with the highway undivided.

When RESULTS are Needed Specify— INTERNATIONAL POWER

Six International TracTracTors were used in the construction of the new $3,000,000 Portland, Ore., airport. This shows one of the two Diesel-powered TracTracTors pulling a 6-yard carry scraper. The four other units were gasoline-powered and did the bulldozing. Some 4,600,000 yards were dredge fill and an additional 2,000,000 yards were moved by these Internationals in leveling operations.



An International PD-80 six-cylinder Diesel Power Unit at work on a big crusher plant near Maupin, Ore.

LET this sound advice from *experienced* users direct your purchases of industrial tractors and power units. Cash in on the advantages INTERNATIONAL *Performance* and INTERNATIONAL *Economy* bring to the job—advantages that make you feel mighty good when the cost sheets are figured.

International Industrial Power has a reputation for getting things done fast . . . that's why you find the *big* jobs being turned over to International. And when service is needed, the low maintenance cost of each unit in the International line means amazing savings. Wheel and crawler tractors (gasoline and Diesel) for mobile power, and power units (gasoline and Diesel) ranging up to 110 max. h. p. for stationary work are available. See the nearby International industrial dealer or Company-owned branch for complete information.

INTERNATIONAL HARVESTER COMPANY
(INCORPORATED)
606 So. Michigan Ave. Chicago, Illinois

INTERNATIONAL Industrial Power

Placement of Light Sources

In order that the pavement surface shall appear bright, it is important that much of the direct reflection of light from it shall be in the direction of the motorist. With lamps placed at the side of the highway, such direct reflection is largely transverse and the ordinary pavement does not appear very bright to the motorist. This is particularly the case if the light sources be mounted low and alongside the highway. It is therefore important that the light sources shall be well out over the pavement. The tendency is for pavements to present streaks or longitudinal zones of brightness attributable to particular lamps. If all lamps are in a row, this, on a straight highway having somewhat specular or wet pavement, results in a streak (or row of streaks) not wide enough to cover the entire surface of the pavement. If there are several rows of lights the whole road tends to become bright. The ultimate in this direction would be accomplished by a row of lamps over each traffic lane. The fundamental purpose of a highway-lighting installation is to improve visibility, and it is probable that more added improvement in visibility can be effected by judicious transverse placement of light sources than can be secured otherwise for the same expenditure.

It is advantageous to mount luminaries on the *outside* of highway curves and at crests of highway hills or grades. The spacings should be adapted to locate luminaires at these and other critical points.

Problems of spacing, mounting height, and type of equipment are interwoven and mutually dependent. All illuminating engineers are agreed that a large proportion of the light which is produced should be delivered upon the highway and that this should be accomplished with the most uniform, practicable distribution of brightness and with the least practicable glare.

In dealing with all such questions it is desirable to remember that even a little highway lighting has been found to have economic value, and that good highway lighting is distinctly more valuable than poor highway lighting.

4. PRESCRIPTION FOR HIGHWAY LIGHTING

The best practicable prescription in the present state of the art of highway lighting is set forth in the accompanying table which offers the Committee's recommendations for highway lighting.

Difficulty is involved in placing lamps over paved highways where the right-of-way is much wider than the pavement. Highway authorities are naturally reluctant to have poles placed well within the edge of the right-of-way and close to the pavement. But since it is vitally important in highway lighting that the light sources be placed over the pavement and well distributed transversely across the highway (it is sometimes preferable to place a row of lamps over each traffic lane) it is necessary to choose between placement of the poles not too far from the edge of the pavement (even at the expense of probable removal later) and the alternatives of excessively long mast arms or of crossroad suspensions.

The requirements for distribution of light up and down a narrow strip of highway with but little distributed elsewhere leads naturally to designs which are likely to occasion serious glare which militates against the very effectiveness of lighting that is sought. One ready means of reducing such glare is to mount the luminaires high. Notwithstanding the increased costs which this entails, a relatively high mounting height must be advocated in highway lighting with luminaires as usually designed for this purpose.

Light Sources

No distinction is made among light sources as tungsten, high-intensity mercury and sodium lamps.

RECOMMENDATIONS FOR HIGHWAY LIGHTING

The following table sets forth the order of illumination intensity which should be produced on highways. In proportion as traffic density or speed upon highways of stated types is relatively great, the higher average intensities of illumination should be sought. Illustrative spacings and sizes of lamps fitting approximately into these recommendations are presented but other combinations of spacing and lamp size to provide the equivalent illumination may be preferable under some circumstances.

	Pavement Width		
	2 Lanes	3 Lanes	4 Lanes
Pavement permanently light in color			
Lumens upon pavement surface*	of the order of .2 to 0.5 lumen per sq. ft. delivered upon pavement surface		
Illustrative arrangements*			
Luminaire spacing, ft...	240–250	240–250	240–250
Mounting height, ft.....	25–30	25–30	25–30
Lamp Lumens	6,000	6,000–10,000	6,000–10,000
Luminaire spacing, ft...	200	200	200
Mounting height, ft....	25	25	25
Lamp Lumens	6,000	6,000–10,000	6,000–10,000
Luminaire spacing, ft...	125	125	125
Mounting height, ft....	25	25	25
Lamp Lumens	4,000	4,000	6,000
Darker pavements, oil polished			
Lumens upon pavement surface*	of the order of 0.3 to 1.0 lumen per sq. ft. delivered upon pavement surface		
Dull black pavements			
Lumens upon pavement surface*	of the order of 1.0 to 2.0 lumens per sq. ft. delivered upon pavement surface		

*The illumination on the pavement surface which is here recommended may be obtained in a variety of ways, as by larger illuminants spaced more widely or smaller illuminants spaced more closely. Each example of spacings and lamp sizes illustrates one of several possible arrangements. The best selection of arrangements may vary with local circumstances. The illustrations given are based upon the more common pole spacings, but the growing tendency to separate the lighting poles from the rural line will free the lighting design from such restrictions.

Of the total lumens produced under usual conditions, 20 to 50 per cent are delivered upon the highway depending upon the type of equipment employed, the location of the light sources, etc. As large proportions of the light flux are delivered along the highway, glare tends to become more severe unless the utmost skill is exercised in its avoidance. As glare may greatly detract from the effectiveness of the illumination its minimization is at all times of large importance.

No practicable increase in light output of lamps along the side of a highway can compensate for failure to locate the lamps *over* the highway. The following recommendations are based upon the assumption that they will be mounted well out over the highway; on 3-lane and wider highways at least two rows of lamps are recommended.

Lamps should be mounted at least 25 feet above grade. Higher mounting heights usually afford greater lighting effectiveness.

BRICK COSTS FAR LESS PER YEAR OF SERVICE

• Engineers know much more about pavement construction and paving brick manufacturers are making a vastly superior paving brick than they did 50 years ago.

Yet Virginia Ave., St. Paul, Minnesota, brick paved in 1888 will complete its half century of service in a few more months.

Brick pavements can give such service because they alone are so impervious to weather as well as traffic damage.

As built today, brick pavements are smooth, easy-riding. They are safe. They are the best investment that a dollar's worth of paving funds can buy.

Use brick on new construction. Practically any type of failing pavement may be resurfaced with brick, and give long life with low upkeep costs. For data, write National Paving Brick Association (Affiliated with Structural Clay Products, Inc.) National Press Building, Washington, D.C.

"This Pavement 49 Years Old and Still Serviceable"

—says George M. Shepard, Chief Engineer, Department of Public Works, St. Paul, Minn.

Virginia Avenue, St. Paul, Minn.

BRICK

WHEN BIG JOBS NEED DOING

Cletrac does them

Two Cletracs with wagons excavating the new river channel

Bulldozing earth to a levee parallel to the new river channel

10 Cletracs move a river 1000 feet

ALL WINTER "The Battle of the Mud" has been aggressively waged in the Cuyahoga River valley of Cleveland, with a fleet of Cletracs operating under the worst possible conditions one can imagine.

To begin with, the river bed was moved 1000 feet. Then, the entire area had to be raised ten feet above the normal valley level. This required the movement of 750,000 cubic yards of earth. Here was a big job in itself.

But to make conditions worse, the winter was an open one—freezing, thawing and raining continuously. At one time floods came and water covered the entire area.

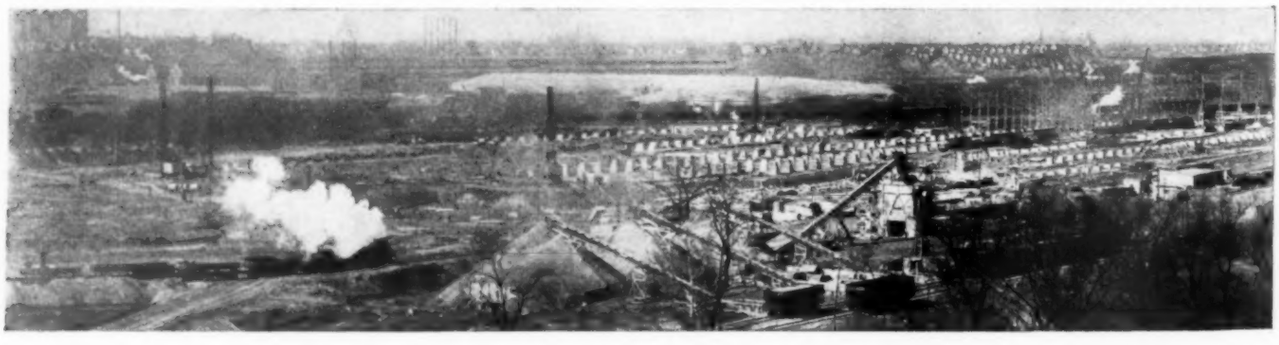
But day and night—rain or shine—thawing or freezing—flood or no flood—ten Cletracs carried on. Without Cletracs and crawler wagons the job would have been impossible.

Where last year a river flowed, there now rises the steel framework of a giant mill—the largest continuous strip mill in the world—a mill that will be completed *on time* because Cletracs carried through.

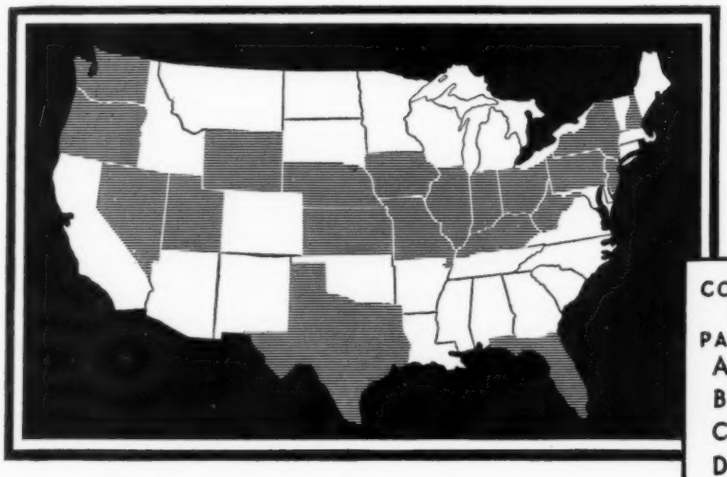
Cletrac
Crawler Tractors
Built by Tractors

THE CLEVELAND TRACTOR COMPANY • Euclid Avenue, Cleveland, Ohio

A modern mill begins to rise on the fill

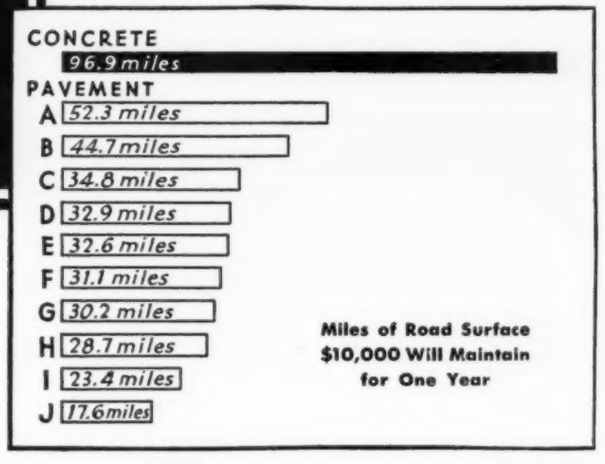


THE MAINTENANCE RECORDS *Speak!*



Official records from the states shown in gray are the basis for the Portland Cement Association's newest summary of surface maintenance costs.

To concrete's overwhelming public preference; to its greater load-carrying capacity per dollar of first cost; to its non-skid, highly visible "safety" surface, add this record of maintenance economy as one more reason for building your roads of concrete.



Concrete saves $88 to $465 per year per mile in surface maintenance, according to most complete summary ever published

What percentage of future road funds must be earmarked for surface maintenance?

How much will be available for urgently needed new construction?

Additional light is thrown on these fundamental questions by a new summary of surface maintenance costs, just published by the Portland Cement Association. This comprehensive study includes all states which release upkeep costs in sufficient detail so that surface maintenance costs can be segregated. There is no selection or exclusion of data.

All Available Records Included

The summary is based on detailed surface maintenance figures from official records of 21 state highway departments. Figures include the latest and all records available.

The periods covered in the various states range from 2 to 16 consecutive years, averaging about 9 years.

134,856 miles of state highways are included—nearly half of the surfaced mileage of state trunk systems, representing a wide range of traffic, subgrade, climatic and other conditions.

Concrete's Economy Clearly Shown

Average surface maintenance costs on 49,000 miles of concrete (over 321,500 year-miles of maintenance) were found to be $103.17 per mile per year.

The average cost on the next lowest paving material was $191.09, nearly double the cost on concrete. This was on a small mileage, much of which was comparatively new. The average surface maintenance cost on all surfaces other than concrete was $359.89, three and one-half times that on the concrete.

Here are the actual figures for the principal road types:

Type of Pavement	Total Mileage	Aver. Surface Maintenance Cost Per Mile Per Year
Concrete	49,336.8	$103.17
A	2,183.4	191.09
B	1,135.5	223.47
C	2,284.3	287.70
D	20,566.9	304.32
E	25,961.2	306.83
F	11,831.4	321.92
G	1,838.2	331.52
H	3,023.6	348.02
I	7,778.9	427.17
J	4,770.4	568.32

Mail the coupon or write for detailed figures.

PORTLAND CEMENT ASSOCIATION
Dept. 6-28, 33 West Grand Avenue, Chicago, Ill.

Please send me, "Road Surface Maintenance Costs from 21 States."

Name _____

Address _____

City _____ *State* _____

IMPORTANCE OF RECORDS UNDER THE SOCIAL SECURITY LAW

By GEORGE P. ELLIS, C.P.A.
Wolf and Company

THE importance of personnel records is one of the features of the Social Security law. So far, the monthly Old Age tax returns (SS-1), the annual Federal Unemployment return (Form 940), and the various State Unemployment Tax returns have not emphasized that fact. But with the filing of the first summary reports on Old Age Benefits, the need of complete employe records is apparent, even if state law requirements were not a factor.

Not later than July 31st, all employers subject to the Federal Old Age Benefits tax, must file a summary report for the six months, January 1-June 30, 1937, inclusive. The forms for making this summary report have just been released; they are Forms SS-2 and SS-2(a). After this first return, the summary reports are to be filed quarterly.

Both these report forms SS-2 and SS-2(a) require that the employer's account number, and the employe's account number be entered. The Bureau of Internal Revenue declares that every employer who filed an application for a number, will be notified of his number before the deadline on filing Form SS-2. If, for any reason, you have employes who have not filed an application for a number, Form SS-5 must be filed immediately either by the employe, or by the employer in behalf of the employe. If the number does not come back in time to enter on the summary reports SS-2 and SS-2(a), the date of application instead of the number must be entered on the summaries.

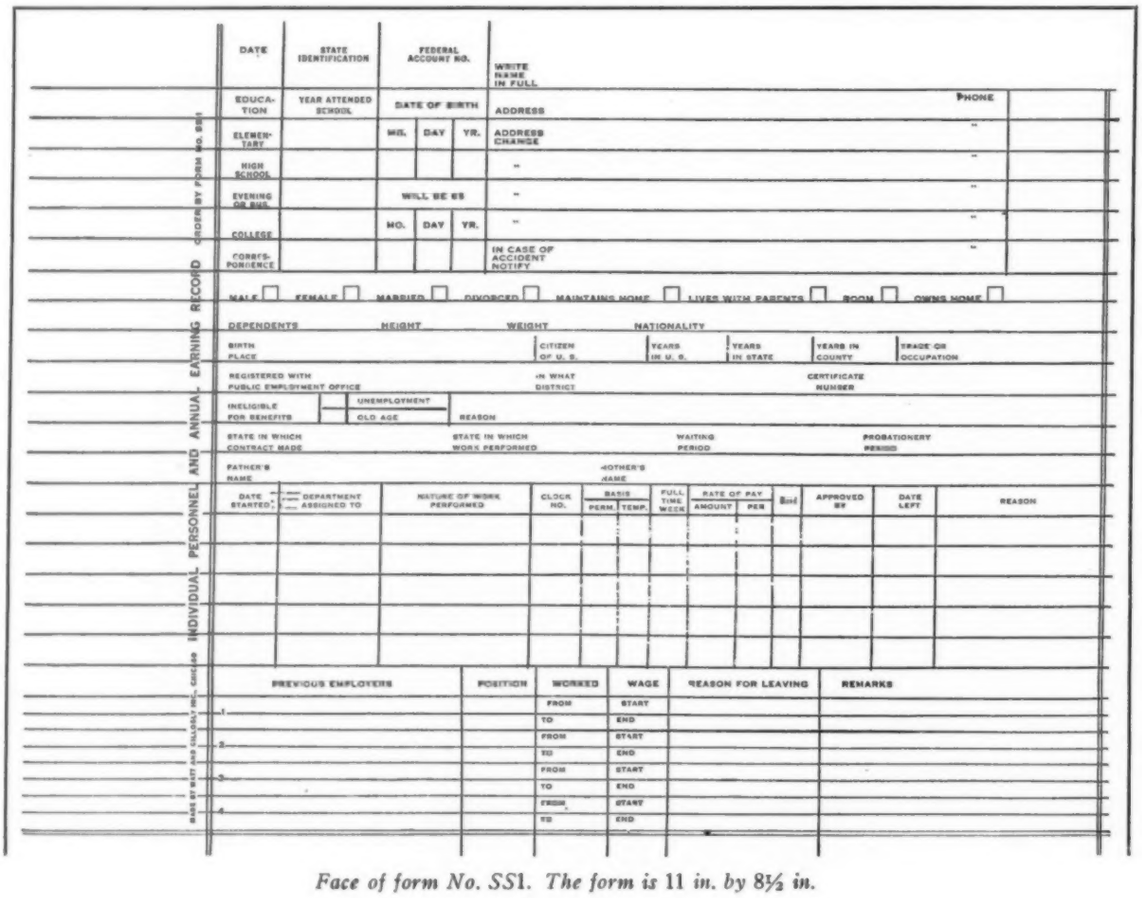
Form SS-2 calls for (1) total number of employes to whom taxable wages were paid in the six months; (2) total taxable wages paid in the period; (3) taxable wages paid for each month of the period as reported monthly on Form SS-1. If there is a discrepancy between the item (2) total taxable wages in the six months' period, and item (3) the sum of the monthly returns, an explanation must be attached.

Attached to SS-2, must be one copy of Forms SS-2(a) for *each* individual employe. On this report must be given the employe's Social Security Account number, and the total wages earned and wages taxable in the summary period.

The Social Security Account numbers have not previously been required.

Other report forms (OAC-1001 to OAC-1006) have been issued in connection with lump sum claims under the Old Age Benefit Section of the Social Security law. As the law now stands, Old Age monthly benefits for qualified persons reaching age sixty-five are not payable until

(*Continued on page* 71)



Face of form No. SS1. The form is 11 in. by 8½ in.

ANNUAL SUMMARY OF EARNINGS AND TAXES

NAME

YEAR	WORKED		TIME LOST		TOTAL CASH	DEDUCTIONS				NET CASH	NON-CASH	GROSS	TAXABLE EARNINGS	
	D	H	D	H	EARNED	FEDERAL O. A. B.	STATE U. C.		MISC.	RECEIVED	REMUNERATION	EARNINGS	FEDERAL O. A. B.	STATE U. C.
	8				9	10	11	12	14	16	19	20	21	22

Reverse side of form No. SS1 shown on page 68. The form is 11 in. by 8½ in.

January 1, 1942. Employes reaching age sixty-five or dying after December 31, 1936, and before January 1, 1942, are entitled to lump-sum payments.

OAC-1001—Statement of employers in connection with employe's application for Old-Age Benefits must be filled out by each employe worked after 1936.

OAC-1002—Employe's application, requires (1) his account number, (2) year, date and place of birth, (3) a list of all employers and the wages earned with each after 1936.

Other forms (1003-1006) requiring similar data are provided for use when the employe has died, and the claim is filed by relatives, an executor, an administrator, or a guardian.

Since claims of this nature must be filed within fifteen days after the sixty-fifth birthday or the death, and since proof is required to substantiate the age of the applicant, employes approaching age sixty-five should secure and have available either a birth certificate or other documentary information. Both the employer and the employe needs such evidence. It is unwise to postpone getting the information until it is required, for then the time may be too short.

Just recently, the Bureau of Internal Revenue has issued regulations upon the filing of Old-Age tax returns where wages are paid irregularly. (MT:SS No. 4597 of May 20, 1937.)

The Bureau has held that an employer who neither pays nor contemplates paying any taxable wages to his employes, has fulfilled the law if in lieu of filing returns, he files in duplicate an affidavit (for the attention of MT:SS:AA) setting forth

(a) either that he has not paid any taxable wages after December 31, 1936, or that no taxable wages have been paid after a certain date (the late date on which taxable wages were paid), and that all returns required have been filed covering the taxable wages which were paid subsequent to December 31, 1936.

(b) that all employes are serving without remuneration.

(c) that the payment of wages is not contemplated.

(d) that the required returns will be made in the event any taxable wages are paid in the future.

(e) that final returns will be promptly filed in the event he ceases to be an employer.

An employer who pays taxable wages only at regular semi-annual or annual intervals, may be relieved from filing returns on Form SS-1 for months within which no taxable wages are paid, provided written application is made in duplicate to the Collector setting forth the facts of the case and showing the month or months within which wages will be paid.

An employer who pays taxable wages at irregular intervals, or who pays taxable wages at regular intervals but oftener than semi-annually is required to file the monthly reports on SS-1.

In any case, summary reports on SS-2 must be filed, whether or not taxable wages were paid; but in those quarters in which no wages were paid, the Forms SS-2(a) reporting each employe's wages need not be attached to the summary report Form SS-2.

State Unemployment Compensation laws require data upon where employment occurs (if in more than one state), reasons for leaving, details of compensation other than cash, time lost and reasons therefor, and nature of work. Wisconsin is, at present, the only state paying Unemployment Compensation, and hence our only guide so far to the amount of required information.

As other states reach the payment stage, it will be possible to generalize to better advantage. For the need of explicit information is apparent when benefits are due.

The complete Personnel Record for Social Security tax purposes seems to demand:

Name and address.
State identification number if separate from Federal.
Federal Account number.
Birthday (day, month and year).
Date becoming sixty-five (day, month and year).
Birthplace.
Names of parents.
Citizenship and years in state, county.
Trade or occupation.
If registered in a public employment office, the district, and the certificate number.
Eligibility for $\frac{\text{Unemployment Compensation}}{\text{Old-Age Benefits}}$: Reason
State in which contract of hire made.
State in which work mainly performed or "localized" for tax purposes.

INDIVIDUAL EARNINGS AND EMPLOYMENT RECORD

NAME

ADDRESS PHONE NO. CLOCK NO.

ADDRESS PHONE NO. CLOCK NO.

ADDRESS PHONE NO. STATE IDENTIFICATION NO.

HOW PAID—WEEKLY ☐ SEMI-MON. ☐ MONTHLY ☐ AGE THIS YEAR DATE FED. ACCOUNT NO.

PERIOD ENDED	WORKED		TIME LOST			RATE PER	TOTAL CASH	DEDUCTIONS				NET CASH	NON-CASH	GROSS	TAXABLE EARNINGS	
YEAR	D	H	Code	D	H		EARNINGS	FED. O. A. B.	STATE U. C.		MISC.	RECEIVED	REMUNERATION	EARNED	FED. O. A. B.	STATE U. C.
	3					5	9	10	11	12	14	16	19	20	21	22

Face of form No. SS2. The reverse side is printed the same. Summary lines for 3 months, 6 months, 9 months and 1 year are provided. The form is 11 in. by 8½ in.

FOLIO NO.

	NET CASH PAID			NON-CASH REMUNERATION			GROSS	TAXABLE EARNINGS			EARNINGS NOT TAXABLE							
	AMOUNT	CHECK NO.		KIND	VALUE		EARNED	FEDERAL O. A. B.	STATE U. C.	FEDERAL U. C.	KEY	FEDERAL O. A. B.	KEY	STATE U. C.	KEY	FEDERAL U. C.		
	16	17		18	19		20	21	22	23	24	25	26	27	28	29		
																		DO NOT USE THIS SPACE.
1																	1	USE REVERSE SIDE FOR FIRST PERIOD
2																	2	CUT OFF THIS SPACE AT LINE AT LEFT FOR SUBSEQUENT PERIODS TO AVOID REWRITING NAMES
3																	3	

Face of form No. SS3. This form is 14 in. by 11 in. and contains lines numbered up to 35 with a summary line at the bottom.

Waiting period under state law, before becoming eligible for Unemployment Compensation benefits; and time accumulated toward eligibility.

Employment record:
—date started.
—assignment.
—nature of work.
—clock number.
—basis of employment: permanent or temporary.
—full-time week (hours).
—Rate of pay (amount, per)
—Bonded.
—Date of leaving.
—Reason for leaving.

Previous employment:
—names of employees.
—dates.
—wages.
—position.
—reason for leaving.

All this information is little more than good accounting requires anyway. It should be kept in two separate records—a complete payroll record, and an individual employe record.

Complete accuracy is essential, also permanence. The Social Security law is very specific that the records must be kept in a secure place, and accessible to revenue agents who may require to see them, for at least four years from the due date of the tax for the calendar year to which they relate. (Art. 307, Regulations 90, and Art. 412, Regulations 91.

Moreover, the records must be concentrated at the employer's principal place of business or at such other place as the Commissioner may approve.

Form No. SS-4—Individual Personnel Information Form.

Form No. SS-5—Statements of Tax Deductions to Employes.

Samples of the above named forms are shown herewith. Designed by Wolf and Company for recommendation to clients, these five forms are carried in stock, by Watt and Gillogly, 7 S. Dearborn St., Chicago, ready to ship.

Form No. SS 1—Individual Personnel and Annual Earnings Record.—This form serves a dual purpose. The front side is a personnel record which embodies not only the information likely to be required for Social Security purposes, but also personal history data otherwise useful tothe employer. The reverse side provides a 20-year record of annual employment, earnings, and tax deductions, to be posted annually.

Form No. SS 2—Individual Earnings and Employment Record.—The amount columns in this record are numbered to correspond with the amount of columns in the Payroll Record from which they will be posted. Space is provided for "Time Lost"—Code (Reason): Days; Hours. This information may be required in connection with State Unemployment Compensation. Lines are provided for totals at the end of each three month period and year to-date, to facilitate the compilation of quarterly information returns under Federal Old Age Benefits. The two sides of this form provide space for weekly postings for a full year.

This record should be filed by Clock Number, where

SOCIAL SECURITY PAYROLL RECORD FOR 19 FOLIO NO.

FEDERAL ACCT. NO.	NAMES		CLOCK NO.	TIME DAYS	TIME HRS.	RATE PER	CASH EARNINGS WAGES	KEY	CASH EARNINGS OTHER	CASH EARNINGS TOTAL	DEDUCTIONS FEDERAL O. A. B.	DEDUCTIONS STATE U. C.	DEDUCTIONS	DEDUCTIONS MISCELLANEOUS	DEDUCTIONS TOTAL	
1	2		3	4		5	6	7	8	9	10	11	12	13	14	15
XXX	AMOUNT FORWARDED	X														
		1														1
		2														2
		3														3

Reverse of form No. SS3. Like the other side, there are 35 numbered lines on this form.

No particular or uniform system of accounting is prescribed, so long as the necessary information is obtainable.

Wilful failure to keep the required records is punishable by a fine of not more than $10,000, or imprisonment for not more than one year, or both, together with the costs of prosecution. (Art. 502, Art. 412, Social Security Regulations 90 and 91, and Sec. 1114 of the Revenue Act of 1936.)

FIVE ESSENTIAL SOCIAL SECURITY RECORDS

Form No. SS-1—Individual Personnel and Annual Earnings Record.

Form No. SS-2—Individual Earnings and Employment Record.

Form No. SS-3—Payroll Record.

employes are so designated; otherwise alphabetically—in any case in the same arrangement as used for names in Payroll Record Form, to facilitate consecutive posting.

Form No. SS 3—Payroll Record.—After the names are written in for the first payroll on this form, sheets for succeeding payroll periods are cut off at the line at the left of clock number, so that the originally written names are applicable to each succeeding payroll without rewriting. The information pertaining to each employe's name is spread on two folio pages, in columns 1 to 29.

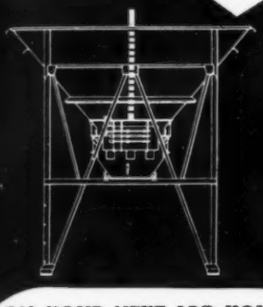
Cash Earnings pertain to (6) Salary or Wages of regular payroll; (7) and (8) to the kind and amount of any additional cash compensation, such as commissions, periodical bonus, etc. The operation then shifts to "Non-Cash Earnings" (if any)—(18) Kind; (19) Value. The sum of amounts in columns (9) and (19) is then posted

(*Continued on page 76*)

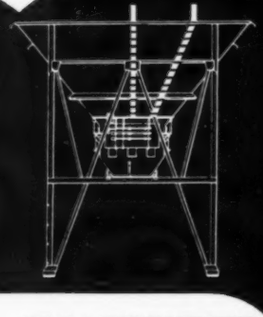
ADVERTISING PAGES REMOVED

ONLY

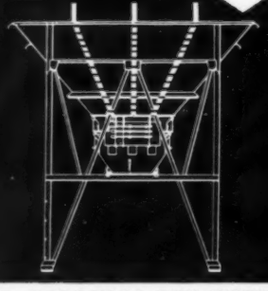
YOU BUY THIS 2 COMPARTMENT BIN



ON YOUR NEXT JOB YOU CAN CONVERT TO A 3 COMPARTMENT BIN LIKE THIS



...OR A 4 COMPARTMENT BIN LIKE THIS...



THE ORIGINAL BIN DESIGN PROVIDES FOR THESE CONVERSIONS TO BE MADE RAPIDLY AND ECONOMICALLY

IN BLAW-KNOX BATCHERPLANTS

you buy

VERSATILITY

Look ahead when you buy a bin and batcher, beyond your present job. Buy a *versatile* Blaw-Knox BATCHERPLANT—convertible to varying needs and specifications—to use on many jobs.

As your requirements change, add bin bulkheads at slight extra cost to suit your aggregate specifications.

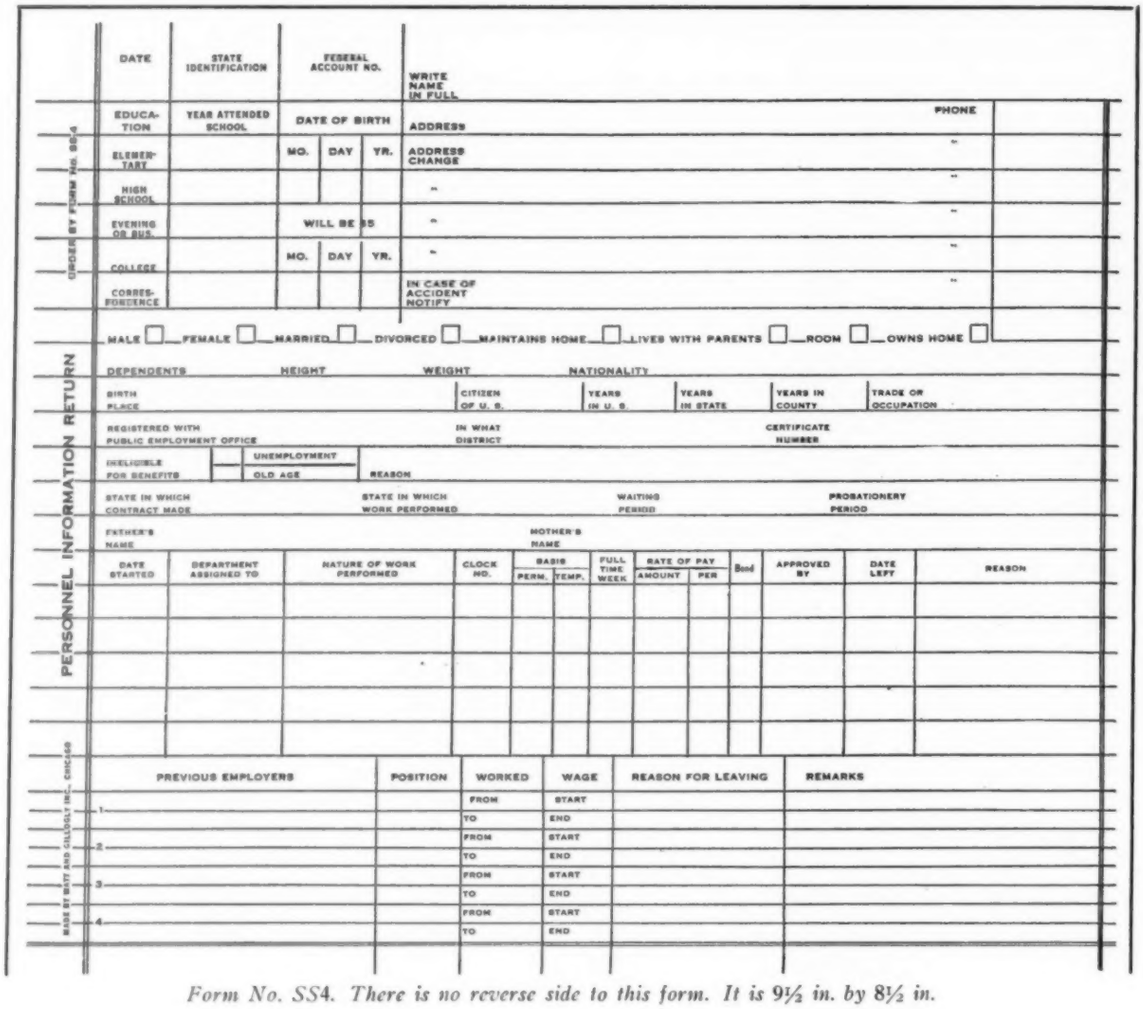
The Weighing Batcher you buy originally is designed to accommodate extra weighing beams to meet these changing conditions, the cost of extra weighing beams is nominal.

Only at Blaw-Knox can you buy this changeability in a standard, shipped from stock, Batcherplant—with the added features of self-cleaning bin design; ease of erection; accurate, simple and dependable weighing batchers—and rugged construction to last through a number of jobs.

We will gladly send you complete details.

BLAW-KNOX COMPANY
FARMERS BANK BUILDING PITTSBURGH, PENNA.
Offices and Representatives In Principal Cities

BLAW-KNOX



PERSONNEL INFORMATION RETURN

DATE | STATE IDENTIFICATION | FEDERAL ACCOUNT NO. | WRITE NAME IN FULL

EDUCATION | YEAR ATTENDED SCHOOL | DATE OF BIRTH | ADDRESS | PHONE

ELEMENTARY | HIGH SCHOOL | EVENING OR BUS. | COLLEGE | CORRESPONDENCE

MO. DAY YR. | WILL BE 65 | ADDRESS CHANGE | IN CASE OF ACCIDENT NOTIFY

MALE ☐ FEMALE ☐ MARRIED ☐ DIVORCED ☐ MAINTAINS HOME ☐ LIVES WITH PARENTS ☐ ROOM ☐ OWNS HOME ☐

DEPENDENTS | HEIGHT | WEIGHT | NATIONALITY

BIRTH PLACE | CITIZEN OF U. S. | YEARS IN U. S. | YEARS IN STATE | YEARS IN COUNTY | TRADE OR OCCUPATION

REGISTERED WITH PUBLIC EMPLOYMENT OFFICE | IN WHAT DISTRICT | CERTIFICATE NUMBER

INELIGIBLE FOR BENEFITS ☐ UNEMPLOYMENT ☐ OLD AGE | REASON

STATE IN WHICH CONTRACT MADE | STATE IN WHICH WORK PERFORMED | WAITING PERIOD | PROBATIONERY PERIOD

FATHER'S NAME | MOTHER'S NAME

DATE STARTED	DEPARTMENT ASSIGNED TO	NATURE OF WORK PERFORMED	CLOCK NO.	BASIS PERM.	BASIS TEMP.	FULL TIME WEEK	RATE OF PAY AMOUNT	RATE OF PAY PER	Bond	APPROVED BY	DATE LEFT	REASON

	PREVIOUS EMPLOYERS	POSITION	WORKED	WAGE	REASON FOR LEAVING	REMARKS
1			FROM	START		
			TO	END		
2			FROM	START		
			TO	END		
3			FROM	START		
			TO	END		
4			FROM	START		
			TO	END		

ORDER BY FORM NO. SS-4

MADE BY BEST AND CALLICOTT INC., CHICAGO

Form No. SS4. There is no reverse side to this form. It is 9½ in. by 8½ in.

in Column (20), Total Earned. The amount of an individual's "Total Earned" which is taxable, to either the employer, the employe, or both, is then extended in columns (21) Federal Old Age Benefit; (22) State Unemployment Compensation (23) Federal Unemployment Compensation.

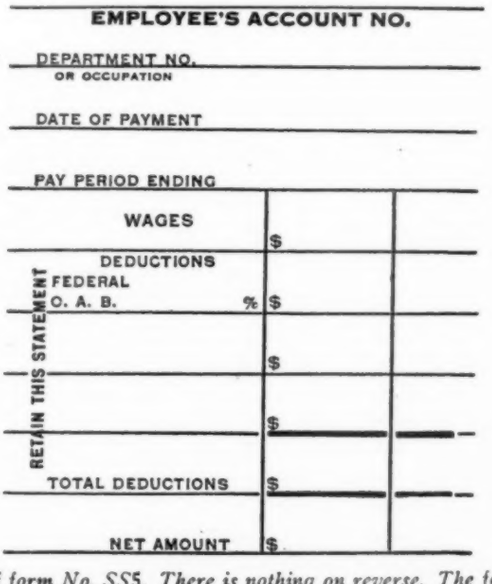
Amounts of "Earnings Not Taxable" are posted in columns (25), (27) and (29), using a predetermined code letter to indicate in columns (24), (26) and (28), the reasons for exempted amounts.

The amount of pay withheld by employer, for employe's contribution in each affected tax classification, is then calculated (taxable amount times effective rate) and is posted in affected tax deduction columns (10) and (11). The sum of tax deductions plus other deductions (12) and (14) is posted in column (15) Total Deductions. Net Cash Paid (9) minus (15), is posted in column (16). Check number in column (17).

Form No. SS 4—Individual Personnel Information Form.—This form is a facsimile of the personnel information required for Form SS-1, and provides an inexpensive means by which employes may furnish the information, in their own handwriting, subsequently to be typewritten on Form SS-1.

Statement of Tax Deductions to Employes.—Such a notice as required by law (Title VIII-Art. 206) may be (1) furnished as a detachable notice-stub attached to payroll check; or (2) printed on pay envelopes; or (3) provided as a separate notice to accompany wage and salary payments as on Form SS-5, herewith.

The form provides 16 separable tax deduction statements on one page and is designed for convenient typing. The firm name and dates may be rubber stamped on each ticket.



EMPLOYEE'S ACCOUNT NO.

DEPARTMENT NO. OR OCCUPATION

DATE OF PAYMENT

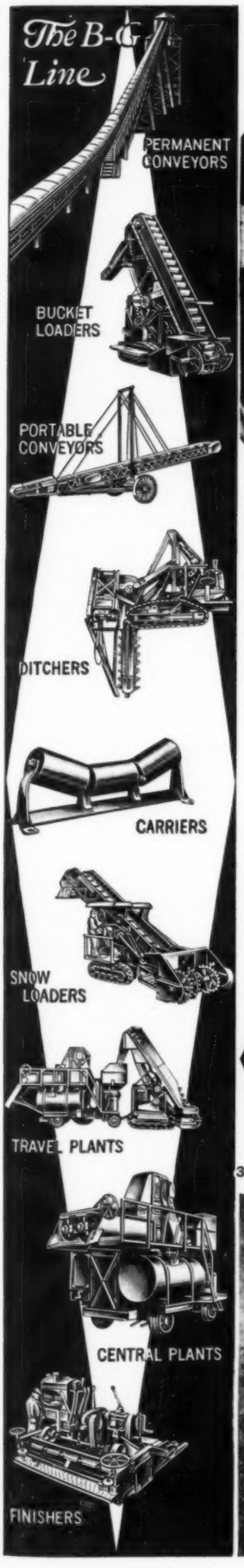
PAY PERIOD ENDING

WAGES	$	
DEDUCTIONS		
FEDERAL O. A. B. %	$	
	$	
	$	
TOTAL DEDUCTIONS	$	
NET AMOUNT	$	

RETAIN THIS STATEMENT

Face of form No. SS5. There is nothing on reverse. The form is 11 in. by 17 in. and contains 16 account cards like this one. It is called "Statement of Social Security Tax Deductions to Be Furnished to Employees."

ADVERTISING PAGES REMOVED



Can you Compete without a Loader?

THE primary advantage of the Bucket Loader is simple—it is the cheapest means of loading bulk material. It will probably pay for itself even though you have other equipment now being used for loading. It is generally regarded as one of the most valuable tools for contracting. In addition to low cost, high capacity loading, it is advantageously used for screening, stripping, light excavating, accurate grading, backfilling, etc.

The B-G 82 Bucket Loader is an outstanding achievement in equipment design. Synchronized Feeding gives higher capacity with less power consumption; the Automatic Overload Release protects the machine, eliminates delays; Slow Crowding Speed gives easier, more efficient operation; Fast Traveling Speed saves money and time; Tank Type Chassis Frame gives greater strength, and encloses all driving mechanism; Floating Boom allows crowding thrust to go direct from crawlers to feeding end; the Full Crawler Mounting gives maneuverability that saves time on every move; and the B-G Snow Loader boom can be mounted on the same chassis.

It will pay you to investigate the Barber-Greene Bucket Loader.

Just ask for Bulletin 82, there is no obligation.

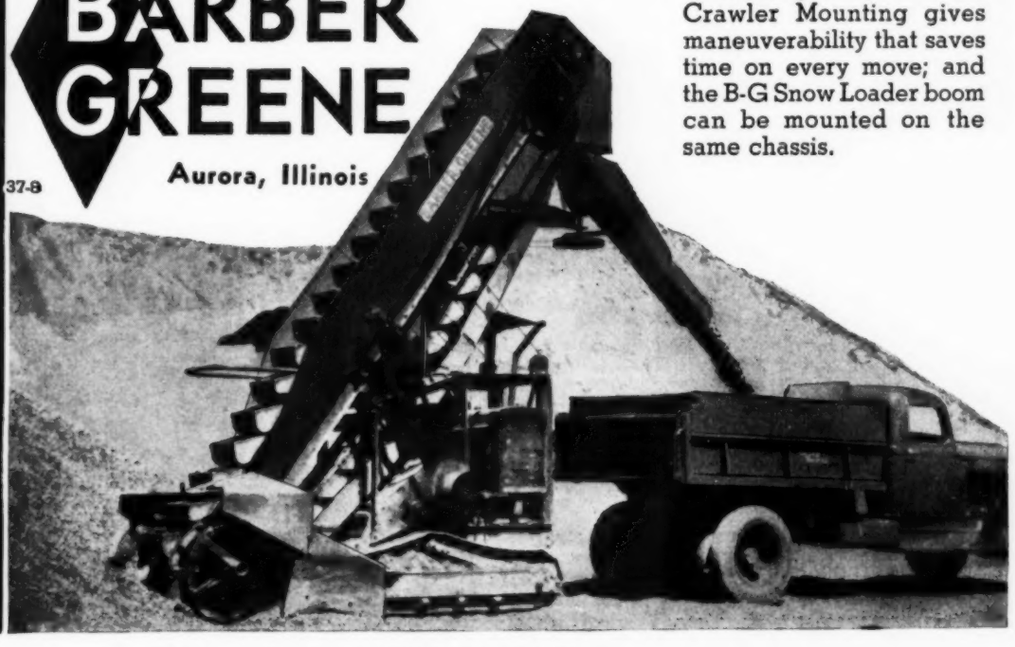
Also ask for our new 52 page booklet "Good Roads" which shows the complete line of Barber-Greenes for contracting.

510 West Park Avenue
Aurora, Illinois

BARBER GREENE

Aurora, Illinois

37-8



Sidelights on an Engineer's Life on Highway Work in Guatemala

THE following is extracted from a letter by Mr. A. K. Haxtun, Ascunion Mita, Guatemala, to Mr. C. N. Conner, Washington, D. C.

Thanks for your letter and Vic Brown's invitation to write a piece for ROADS AND STREETS, but to tell the truth there isn't much to write about. We have one bridge under way a couple of miles out of town here and five or six little bridges and culverts between here and El Salvador and have two tractors and about 100 men grading on the new location. We have made a hundred miles or so of P line and quite a bit of location.

The country is a bit rough. Here in town the elevation is about 1,650 feet or 504 meters but right behind the house and the town is a volcano 8,000 or 9,000 feet high and there are ranges of mountains on every hand. We are sticking to maximum 7½% per cent grades and 114.72 meter radius curves (10 degree metric) but it takes a lot of looking to get it in the hills. The 7½ per cents do not exceed 400 meters in length. I don't like them much but it is practically impossible to get less under the circumstances.

Do you remember several years ago we had an argument about safety on highways and what engineering could do to promote it? At that time I maintained that the stupidity of the average car driver would keep well ahead of any improvements that engineering could effect. As I read the death toll since that time it looks as if I were right.

The roads here are not so good. I think that ours were the first road plans ever in the country. It has been quite a struggle to get them to pay any attention to stakes. The first thing they do is to knock them all out.

Returning to the roads, there are quite a lot of 20 to 25 per cent grades and curves with a radius of not more than 15 or 20 feet. There is a climb of 2,000 feet a mile or two out of town here. Even with the little traffic, three cars have sailed off it since I have been here. On our new location the alignment is 60 or 70 per cent tangent, maximum curve 114.72 meters or about 400 feet and maximum grade 7½ per cent and not much of that, mostly 6 per cent. I believe there is less grading than on the present location. I prowled those hills two months to get that line through.

We have a lot of fun here. We have 11 parrots of four varieties, two deer we raised on a bottle, a kinkajou, a monkey, a coon, two squirrels, a little toucoa, a small model of ostrich, and 17 wild ducks that we raised. They are all tame. It's about 10:30 p. m. as I write and the ducks are untying my shoes and biting my legs until I have to slap them off about every two minutes, but that doesn't discourage them at all. There also are two radios—one electric and one battery. We get about everything—Japan, Siam, Australia and way stations. Right now, Crossley is coming in good and the Ford and General Motors hours were fine tonight. Golf is out. There are a couple of courses in town, but I don't get there oftener than once in two months and then there is no time. We work Sundays and every other day. We have had one day off in a year and a half and then I was curled up with a tummy ache.

Did you go to the road show? We had a man there from here, a Mr. Bickford. I asked him to look you up but haven't seen him since he came back.

All our stuff has to come in through El Salvador and be hauled 35 miles in trucks. I went over there today. It's a pretty rough trip, lots of customs houses, immigration stations and traffic stations. They know me pretty well now, so make out fairly well.

We are putting in the river fill, some 20,000 cubic meters, with a pile driver and a Sauerman crescent bucket. Don't know yet how it is going to work out.

The whole country around here is cut up with old lava flows, fissure eruptions and lots of curious formations. Right on the edge of town are some primitive Pre-Mayan temples. One of them is 40 or 50 feet high, made of flat stones put together with lime. We have gotten some rather good Indian pots and jars out of some of the little mounds. They are very old but the painting and colors on some are excellent even now. There was even one Jade ring.

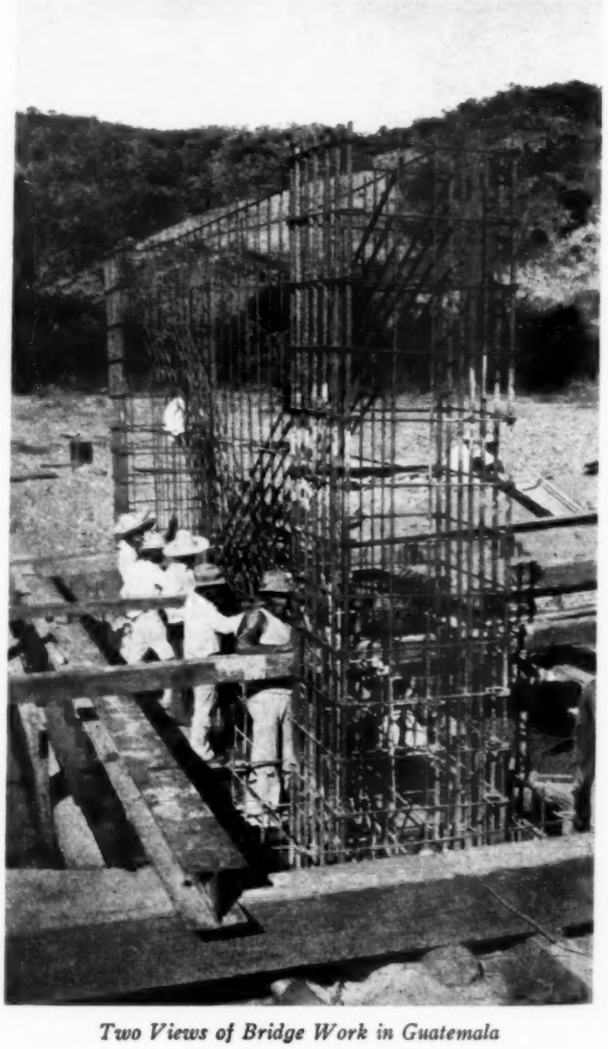
There were also a lot of arrow and spear heads of Obsidian. There is a whole mountain of it three or four miles to the East. These birds never learned of the bow but they devised some sort of throwing stick that worked pretty good. The workmanship on the spear heads is good.

The snakes are bad in these parts; perhaps Mr. James showed you his Bell tail skin. How it missed hitting him, I don't know. It was a sour customer. Last week a snake about 7 feet long got up in the tractor and came out when the tractor was on top of the fill. All the lads on the fill, some eight or ten, sailed off promptly and the snake got back in the tractor again and rode it back to the borrow pit where it came out and was killed.

If anything occurs that would be interesting to write about, I'll send you an article for Vic Brown, but it is all pretty humdrum and there is nothing of particular interest. Enclosed are a few pictures.

AKH

Mr. Haxtun is working on the projects on which the U. S. Government is giving financial aid in Guatemala. In due course of time, the projects will be part of an Inter-American Highway.



Two Views of Bridge Work in Guatemala

Get this:

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SOME JOBS should be tackled with *nothing less* than pre-formed rope, and your job may be one of the toughest.

If so, you'll need all the strength and stamina, the uniform wear and handling ease that our pre-forming process puts into wire rope.

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RAILWAY GRADE SEPARATION IN INDIANA

(Slides and Explanatory Notes presented at the 1937 Annual Purdue Road School in connection with the discussion of "Progress in Railway Grade Separation and Protection Work in Indiana," by J. V. Smythe.)

BEFORE

Eastern part of Gary, N. Y. C. R. R. over U. S. 12 and 20. Average week day traffic in excess of 8,000 vehicles per day. Four lane pavement going out of Gary changes to two lane on a short, sharp curve through subway. Scene of many bad accidents

AFTER

New superstructure span designed and erected. Old pier remodeled. Old abutment removed. New abutment constructed. Clear opening 88 ft. Four lane pavement 40 ft. wide. Structure designed by Railroad. Contract handled by State. 1935 N.R.M. Project. Cost, about $76,000

S. R. 136 over B. & O. at East Edge of North Salem in Hendricks County. Old creosoted timber bridge built by Railroad about 1929. In good condition except floor and very flimsy handrails. Two approach spans on 12% grades. Center span level. Structure not long enough. Sight distance about 100 feet. No shoulders nor guard rail on approaches. Very dangerous, but amount of traffic over road did not warrant very great expense

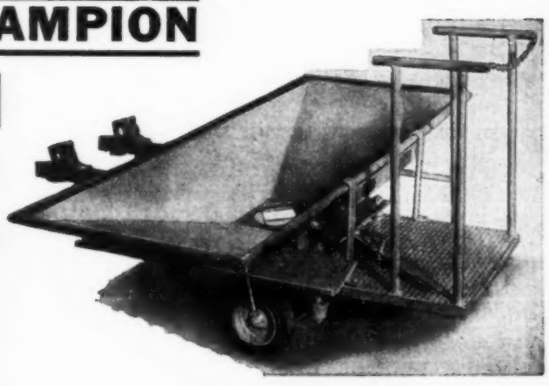
Old floor replaced with new creosoted timber floor. Old handrails replaced with new creosoted timber handrails. Timber wheel guards added. Outer ends of old approach spans raised. New approach spans added at either end. Ends of all spans placed on 700 ft. V.C. connecting 6% grades, thus increasing sight distance to 500 ft. 8 ft. shoulders and guard rails provided on new approaches. Cost, $20,000

Crossing of S. R. 123 and N. Y. C. & C. S. S. & B. high speed electric. West of South Bend. Note poor visibility from either direction. Also note Railroad protected by flashers. Electric line is not. Tracks 70 ft. apart and 5 ft. difference in elevation

New structure on slight relocation. Note old road and difference in elevations in foreground. 7 Span R. C. G. with open bents. Note collision walls adjacent to tracks. Beyond limits of picture, to right, the approach goes over a county road (Ardmore Trail) — Fills not complete. Bridge not open. W.P.G.S. Project. Cost, $122,000

Good Roads

CHAMPION MODEL "D" CHIP SPREADER



For spreading chips, cinders and sand, this spreader is unequalled in strength, reliability, and economy. A spinning disk distributes the material evenly to any desired width up to 14 feet. It is equally efficient for surfacing roads in summer, and sanding icy streets in winter. Full information can be had by writing for Bulletin No. 58.

GOOD ROADS MACHY. CORP.
KENNETT SQUARE PENNSYLVANIA

When You Think of a Vacation Come and See Us

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A Beachfront Hotel Just Off Beachfront—On Beautiful
NORTH CAROLINA AVENUE
ATLANTIC CITY

Serving a Tray Breakfast to your room any time up to 11 o'clock without any charge for breakfast or service

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Every Room Has Private Bath

As Low As **$2.50** SINGLE

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Harry L. Fairbairn, Proprietor
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ONE MAN SETTING-UP WITH HELTZEL FORMS SAVES US TIME and MONEY

Here's a bit of cold logic for you to consider! It's *true* that time spent wrestling with slow-to-set forms is *time and money wasted.* It's *true* that Heltzel Steel Road Forms give you the great advantage of *one-man setting.* And it is correspondingly true that when you standardize on Heltzel Forms, labor costs take *a change for the better!* Write us for the facts.

THE HELTZEL
STEEL FORM & IRON COMPANY
WARREN, OHIO

EDITORIAL

Specify Performance Desired

WHEN a highway engineer, state or county, decides to purchase road building equipment, what, exactly, does he have in mind? Does he want to purchase a unit constructed or manufactured after his design? The answer seems to be negative. Does he have in mind a machine of commercial manufacture? The answer to this is hard to determine. Does he have in mind certain roadbuilding results that he desires accomplished? The answer may be positive but his method of selecting a machine for that job does not seem to indicate that such is the case. Why? you ask. It seems that what the engineer should have in mind is the accomplishment of a certain specific roadbuilding result at the least unit cost. If this is true then it is difficult to understand why he should specify how and of what materials a piece of equipment should be manufactured.

A custom is growing amongst engineers whereby they are making their equipment bidding specifications more and more specific. Not more and more specific as to results to be accomplished by the machine but more and more specific as to how the machine shall be built. It is believed that their purpose is well intended toward establishment of minimum requirements of performance, considering operating cost, length of life, output, repairs, and service.

The same technique that governs bids on highway work is being applied to the purchase of equipment. This technique introduces difficulties that should be avoided. Engineers generally are not informed on patent conditions which govern design to a great extent. The road is built to order. In the case of equipment to do road building, machinery is built to do a certain job, produce a certain result, in a certain way.

Designers of equipment have different things in mind when they build a machine. The more definite the bidding specifications, the more it tends to level off the performance of all makes of machines. The legal requirement that the low bid must be accepted further tends to reward shoddy design and workmanship, with the result that the "cheapest" machine probably will cost more, in the end. Furthermore, there is no incentive to improve design or construction; the manufacturer who makes a machine that will out-perform an older model automatically is limited in selling, just because engineers have set up in their specifications, a standard of requirements based upon mechanical construction and design which omits newer model advantages. Seldom do they give performance a place in their requirements.

It is probable that most engineers will admit the limitations of present specifications and buying methods, but they cannot see any other way, in face of present legal limitations. They will admit that the result, at present, often is very silly, and they know it. The question is, how to do differently?

There seems to be no practical way in which this difficulty can be overcome insofar as all machines are concerned. Where machines are nearly alike in performance, there is no way in which selective specifications can be drawn up on a performance basis. This applies more to the simpler machines. But where there is a real difference between performance of units of equipment or in output, it should be possible to make the specifications cover the different features of performance rather than to center around construction. In some cases, it may be necessary to combine performance and machine construction specifications.

The form of specification which stipulates the requirements as to performance, might be accompanied by a questionnaire to be tendered by the bidder, showing in detail just how he accomplishes the performance result that he claims. This form of making bidding specifications has the advantage that the engineer can reasonably select the machine that comes closest to specified requirements, even if the price happens to be the highest. If the questionnaire shows sufficient reason for rejecting the low bid on the basis of performance, the engineer can select the unit that meets requirements without being restricted by some low bid that appears.

Another advantage of this form of specification is that it opens the way for further development of new machines which will outperform the present day models. It encourages progress which results in lower costs.

Highway engineers should not be concerned so much as to how a machine is built as to what machine will produce a desired result at the lowest unit cost. Of course, the question of equipment standardization and balanced construction plant are important considerations in the preparation of performance specifications. The lowest priced machine is not always the unit that produces the most economical output.

▼

Union Interference

UNIONIZATION of labor may be a good thing under certain conditions. Certainly it is detrimental to the best interests of the public as far as roadbuilding is concerned in cases of unions which are not financially responsible. Take the case which just happened on an Indiana paving job. The contractor's superintendent had the paving job all organized and was starting operations. A car drove up containing a load of men who were not employed on the job.

They were members of the chauffeurs' union, presumably out of Chicago. On the job four unions are represented—chauffeurs, cement finishers, operating engineers, and labor. The superintendent had placed engineers' union men on the motorized equipment except trucks. The men who drove up in the car, it is claimed, were equipped with baseball bats and a machine gun. The superintendent was told he would have to put chauffeurs on certain machines instead of engineers. What should he do? Should he assert himself or shut the job down until an understanding was had between the unions. Because of the defenseless position of the engineers, he shut the job down. This is a plain case of interference that will cost the public more for paving in the future. The contractor, through no fault of his, was forced to stand a "lost time" loss.

That is not all. The job was bid and awarded last December. In the Spring, I am told, the unions organized and submitted wage scales to the contractor. They were accepted and the job started. Since then a 20 per cent increase has been forced on the contractor. Financial irresponsibility of the unions leaves the contractor no recourse. And we call this a free country!

Why Highway Engineers Prefer Littleford Kettles

• Maintaining our highway system is the engineers' biggest problem today. Present-day depreciation rates require careful study, great skill and modern equipment to keep us on smooth riding roads and streets. That is why so many highway departments use Littleford heaters. Their engineers know they get faster, safer heating at lower fuel costs.

Above is a typical maintenance scene. North Carolina State Highway Department crew using Littleford No. 78-OB heater, equipped with Littleford Motor Spray Attachment.

BLACK TOP ROAD MAINTENANCE EQUIPMENT — LB — SINCE - 1900

LITTLEFORD

LITTLEFORD BROS.
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Killefer road equipment

- Revolving Scrapers
- Revolving Rippers
- Regular Rippers
- Road Discs, or Planers
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Write for Literature

A TIME-TRIED economical maintenance tool to remove "corduroy" or waves from asphalt macadam or oiled roads. Does not disturb road base. A skid reducer and effective ice cutter. Width of cut is 48". Has accurate spring-balanced patented control, unaffected by vibrations. Easy to operate. Weight 7450 lb. Sold by "Caterpillar" distributors everywhere. Write for folder. Killefer Mfg. Corp., Ltd., Los Angeles, California; Peoria, Illinois.

Sold by "Caterpillar" Distributors everywhere. Killefer Mfg. Corp. Ltd., Los Angeles, Cal., Peoria, Ill.

4-B Road Disc, or Planer

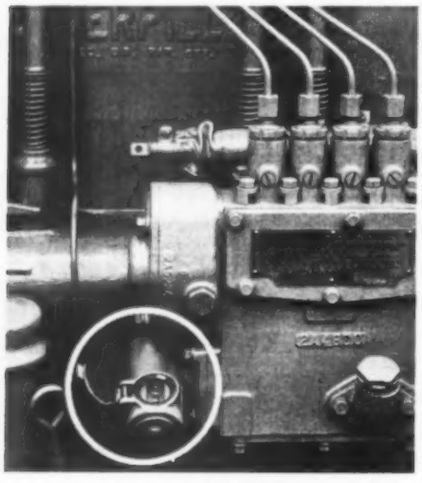
NEW EQUIPMENT AND MATERIALS

Hour Meter Now Standard Equipment on "Caterpillar" Diesel Tractors and Engines

Henceforth an hour meter will be standard equipment on all 3, 4 and 6-cylinder Diesel engines produced by the Caterpillar Tractor Co., Peoria, Ill., according to an announcement made recently.

This meter was made available as an attachment about two years ago. The many that have been used during this period have definitely proved the value of such an instrument and its use, it is claimed, will eventually mean as much to the Diesel engine owner and operator as the speedometer does to the automobile owner.

The hour meter is a sturdy, durable unit with a large dial that is easy to read. It is



The Hour Meter Is Shown in the Circle

attached to the rear of the fuel injection pump housing and is driven by the end of the shaft, fitting between the heads of the cap screws in the end of the fuel injection pump camshaft. The hour meter registers one number for every hour the engine operates at standard rated speed.

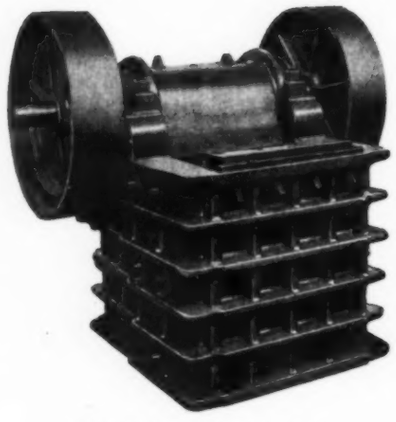
Just as the mileage indicator part of the speedometer has become the standard for measuring the life and maintenance intervals of the automobile, so will the hour meter be generally used as a guide for lubricating and maintaining the "Caterpillar" Diesel engine.

▼

New Jaw Crusher

A jaw crusher, having a 24 in. by 36 in. opening and weighing only 16 tons has been brought out by the Pioneer Gravel Equipment Co., 1513 Central Ave., Minneapolis, Minn. Important features of the crusher are:

Electric cast steel frame and Pitman in place of cast iron. The overhead eccentric in place of the swinging jaw, separate Pitman and bottom eccentric. Safety toggle plate which protects the crusher frame against breakage.



Pioneer 2436 Jaw Crusher

The crusher has SKF bearings and mechanical adjustment. The latter is accomplished by operating the adjusting lever, which will raise or lower the pull wedge until the desired opening is obtained. It is not necessary to stop the crusher to change the adjustment. There are no shims to be changed to adjust the crusher.

▼

New Littleford Model "C" Distributor

New improvements have been engineered into the model "C" bituminous distributor of Littleford Bros., 454 E. Pearl St., Cincinnati, O. This distributor is stated to have been the first to introduce the idea of instant cut-off at the spray bars by applying the full force of the suction side of the material pump on the lines, sucking the bitumen in the lines back into the tank. The patented Littleford single valve made this instant switch from pressure to suction possible.

The 1937 model "C" adds to this principle by the use of special suction fittings on the manifold bar and spray bars that prevent the entrance of air through nozzles from breaking the suction until the lines are emptied. This gets rid of bothersome dribble from the bars after cutting off the spray.

Other new features on this new model "C" include a specially designed hood over the spray bars that shields operator and pumping engine from dust, fumes and fog. Streamlined rear wheel fenders protect operator and machine from bitumen, dust and chips thrown by the tires.

The spray bar raises to give ample road clearance between shots. This also helps when applying a "fog" shot. Dust caps seal

New Littleford Model "C" Distributor

the spray bar feed lines against dust and stones while spray bars are removed.

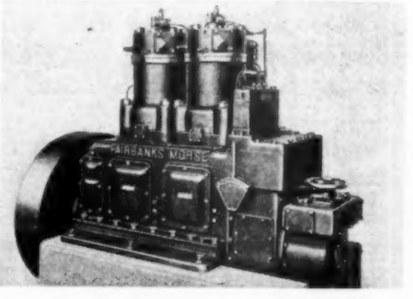
The Littleford low-pressure burner and continuous heat flue has been improved by the use of a special alloy casting for the combustion tube and flue liner. This alloy is so highly heat resistant that no burning out or warping will result with its use.

In addition to these new features, the basic ideas of the model "C"—the Littleford single valve, the crosswise mounting of the pumping engine to cut down overhang, the use of rock wool for insulation, the heat chamber for quick thawing out of pump, valve and lines, the 16x4 pneumatic-tired fifth wheel tachometer drive and pump tachometer—have been worked over with minor changes for the operator's convenience.

▼

New Heavy Duty Diesel for the Small Power User

A new Fairbanks-Morse Diesel, the Model 42-E, has been developed to meet the demand of small power users for a heavy-



Two-cyl. 8¾-in. x 10½-in. F-M Model 42-E Diesel with a rating of 60 hp. at 450 r.p.m.

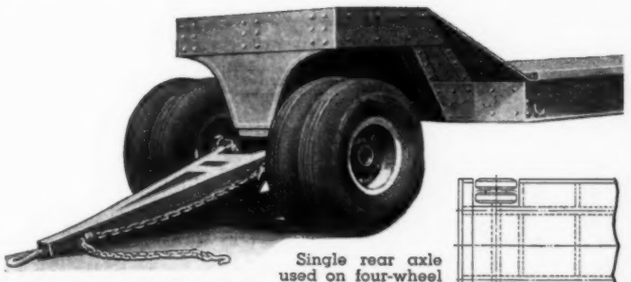
duty, continuous-service stationary engine. It is available in 2-and 3-cylinder combinations with ratings of 60 and 90 hp. at 450 r.p.m., and can be furnished for direct-connected, belt or electric generator drive.

With an 8¾-in. bore and 10½-in. stroke, this Diesel is smaller and lighter than the F-M Model 32-E, but it embodies all of the proven features of the larger engines. It is small enough to be installed where space and head room are limited, and it is applicable for any power requirement within its horsepower ratings.

This new model Diesel is characterized by extreme simplicity of design and operation. Two important principles, direct airless injection of fuel and two-cycle design with crank-case scavenging, are claimed to result in use of an absolute minimum of moving parts.

Cylinder heads are simplified by the elimination of air inlet and exhaust valves with their attendant operating mechanism. All working parts are enclosed, yet are readily accessible for inspection and maintenance.

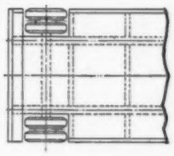
Further details regarding this new F-M Model 42-E Diesel will be found in a bulletin now available upon request from Fairbanks, Morse & Co., 900 S. Wabash, Chicago, Ill.



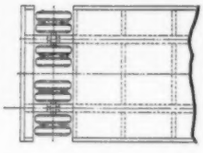
YOUR HEAVY TRAILER PROBLEMS CAN BE SOLVED

at lower cost by C. R. Jahn Standard Trailers. There is a wheel design to care for every load and practically all State Regulations. Ask—

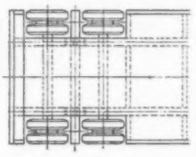
C. R. JAHN COMPANY
Builders Bldg.
CHICAGO



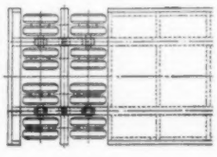
Single rear axle used on four-wheel trailers mounted on single or dual tires.



Dual axles of the oscillating type used on six-wheel trailers placed crosswise of the rear of the frame.

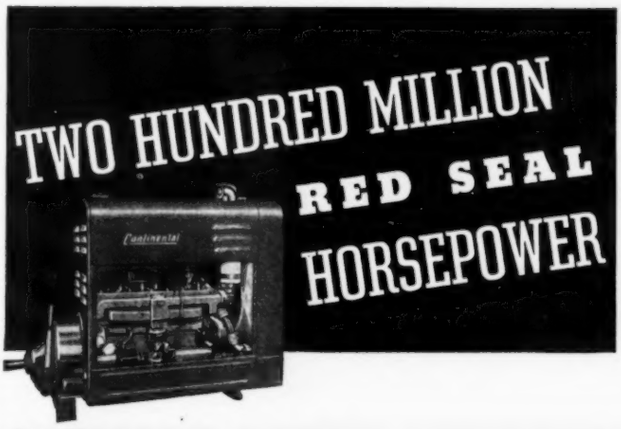


Tandem rear axles used on six-wheel trailers mounted on large rocker beams.



Multiple rear axles in capacities from 25 tons up. Two oscillating axles in tandem and mounted on large rocker beams assure perfect distribution of load over all tires.

COME TO TRAILER HEADQUARTERS



AMERICA'S POWER STANDARD FOR 37 YEARS

At the turn of the century Continental produced the first Red Seal Engine and during the past thirty-seven years millions and millions of Red Seal horsepower have been supplying dependable, economical power for agriculture, industry, transportation and aviation. The Continental Red Seal Engine has become the most famous engine in the world today.

It is significant that today more than three hundred manufacturers use Red Seal Engines as standard equipment. These manufacturers *know* from dynamometer tests, laboratory research and proving ground tests coupled with years of experience in actual operation that Continental Engines are built to "take it"—and built to give a type of husky, rugged performance that cuts both operating and maintenance costs to the bone—with the last word in consistent power delivery.

Regardless of whether you are the man who buys the power equipment or the man who uses it, we believe you will be interested in the many engineering features such as individual porting which make Continental Engines so outstanding. We will gladly send you complete information without obligation. Write to

Continental Engines are used as standard equipment by more than 300 manufacturers. Below are a few of the many applications of Continental Dependable Power.

- Conveyors
- Ditchers
- Drag Lines
- Electric Generators
- Electric Light Plants
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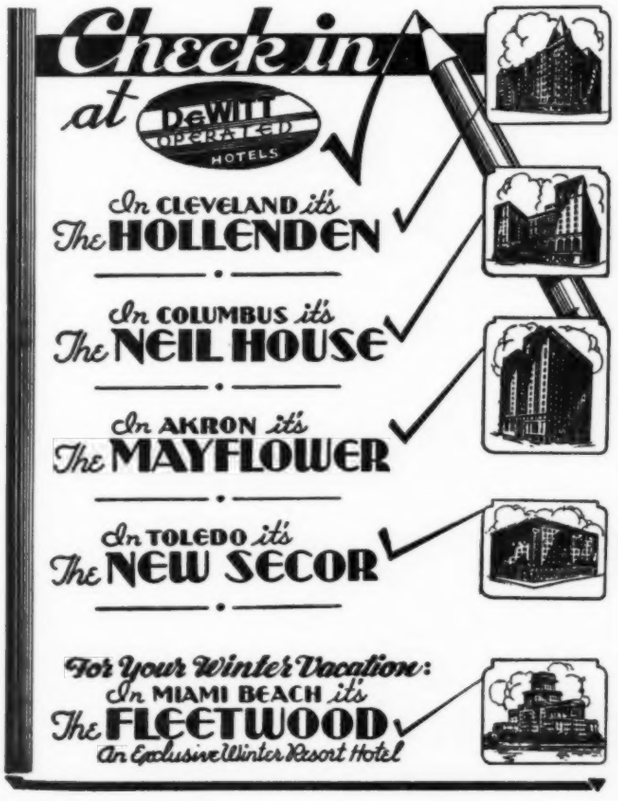
- Excavators
- Farm Tractors
- Graders
- Grinders
- Harvesters
- Hoists
- Hydraulic Machinery
- Industrial Tractors
- Irrigation Pumps
- Loaders
- Mining Machinery
- Mowers
- Pavers
- Pumps
- Road Building Machinery
- Road Rollers
- Road Scrapers
- Separators
- Sprayers
- Stand-by Equipment
- Stone-Gravel Crushers
- Street Sweepers
- Threshers
- Tractors
- Trenchers
- Well Drillers
- Winches

Continental Motors Corporation
Detroit and Muskegon, Michigan
Dependable Power for Every Purpose


Check in at DeWitt operated HOTELS
In CLEVELAND it's The HOLLENDEN
In COLUMBUS it's The NEIL HOUSE
In AKRON it's The MAYFLOWER
In TOLEDO it's The NEW SECOR
For Your Winter Vacation:
In MIAMI BEACH it's The FLEETWOOD
An Exclusive Winter Resort Hotel

New Highway Torch

A new highway torch, placed on the market by the Embury Manufacturing Co., Warsaw, N. Y., is illustrated. In this torch the top of the burner completely protects the flame against rain. It is further stated

No. 750 Luck-E-Lite Highway Torch

that the flame is protected against the strongest wind and the torch will stay lit in roughest weather. The torch has a simple, positive, rapid cam-lock, making it easy to remove and put on burner. The sturdy oil pot is made of 20 gauge steel and has leakproof double seam. The burner hood is of 14 gauge steel. It is stated the torch will burn over 24 hours in strong wind and up to 48 hours in still air on one filling.

▼

Tree-Moving Crane

The Mead-Morrison division of Gar Wood Industries, Inc., Detroit, Mich., announces the production of a new type, tree-moving crane unit with which the entire operation of handling a big tree is done easily by one operator.

The unit is capable of handling a 45-foot tree which, including the ball of earth around the roots, weighs approximately

Gar Wood Tree-Moving Crane. Inset Shows Tree Being Swung on Steel Cradle

18,000 lbs. The gooseneck type crane has a live boom. The crane unit is equipped with a single-and-double drum winch. The single-drum winch handles steel rope capable of a 20,000 lb. pull on a single line. This winch operates the hoisting line, which is secured to the chain mesh encasing the ball of earth. One of the drums of the double-drum winch is used to hoist and lower the boom; the other drum takes the line which is secured to the trunk of the tree. Both of these drums have a capacity rating of 15,000 lbs. pull.

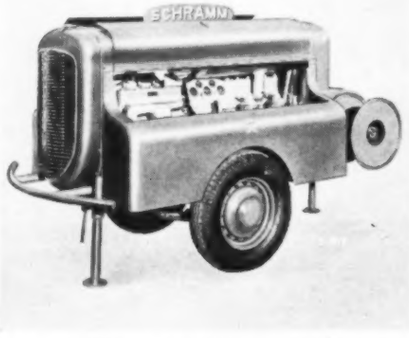
▼

New Lightweight Air Compressor

A new lightweight air compressor has been placed on the market by Schramm, Inc., West Chester, Pa. This machine is available in sizes 85 and 105 cu. ft. actual air delivery in the gasoline engine driven machines and in the 105 cu. ft. size in the Diesel powered unit.

Compressor features include four cylinder, vertical block with lighter pistons; five main bearings; force feed lubrication supplied by gear driven oil pump to all movable parts; mechanical intake valves operated from camshaft in perfect timing with piston travel; electric self-starting, and the Schramm self-aligning clutch between engine and compressor.

The unit is a complete air plant with air and gas tanks compactly under the hood.



Schramm De Luxe "Utility" Compressor

It can be mounted on a half or three-quarters ton truck.

The skid mounting of this outfit is a semi-portable one and has proved to be practical for mounting behind truck cabs on large trucks where it is not desirable to devote the entire truck body to an air compressor. Two portable mountings are offered in the form of a 2 wheel pneumatic tire spring trailer which can be towed at speeds up to 40 miles per hour and the truck mounted DeLuxe which results in a streamlined, portable outfit. DeLuxe features also include two spacious, streamlined tool boxes on either side of the machine. "Live-air" hose reels can be furnished as extras on DeLuxe Models.

Write Schramm Inc., West Chester, Pa., for Bulletin No. 3700-RS.

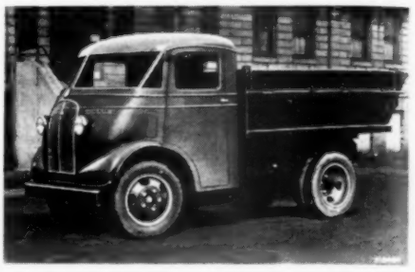
▼

New Cab-Over-Engine Dump Truck Model

Announcement has been made by the Dodge Division of a short wheelbase truck with a new cab-over-engine conversion and special dump body on a 1937 Dodge chassis.

This special body is mounted upon a 1½-ton Dodge truck chassis with a 108-in. wheelbase. The dump body side is hinged horizontally for greater capacity and ease in loading ashes and other bulky materials. The slanting rear gate also gives it slightly greater load space. It is equipped with a hydraulic hoist.

This particular unit is intended for use in city work, although it is adaptable for



New Dodge Cab-Over-Engine Dump Truck Model

numerous other purposes. The short wheelbase provides small turning radius and greater facility for handling in location where little space is available.

▼

New Line Fractional Horsepower Air Compressors

Ingersoll-Rand Co., Phillipsburg, N. J., has announced a new line of fractional horsepower air compressors. These units are made in ¼ and ½ HP. sizes. These units are very compact and neat in appearance. They have automatic start and stop control, are equipped with a new style seamless steel tank, and an improved check valve.

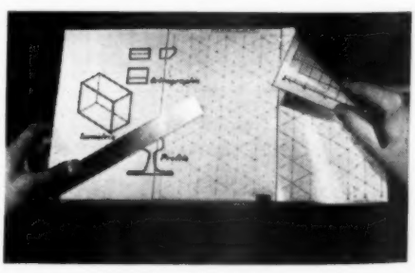
When furnished for single phase current they are equipped with a brushless capacitor type motor and a built-in automatic protection switch giving overload and under-voltage protection. They are rated for 150 lbs. per sq. in. maximum pressure, but may be set for lower pressures, or may be equipped with a reducing valve for still lower pressures.

The ¼ and ½ HP. units are available on a 2.4 cu. ft. tank. This unit is less than 35 ins. high. The ½ HP. size is also available on a 4.6 cu. ft. tank in either vertical or horizontal mounting. If desired the units can be furnished less the tank.

▼

New Sketch Pad Set

A new sketch pad set intended for making any type of sketch to any scale has been



Sketch Pad Set

placed on the market by the Wade Instrument Co., 2274 Brooklyn Station, Cleveland, O. The set consists of a pad of strong tracing paper; a cellulose covered buff guide

★ South Bend ★

Bituminous Material Distributor

Embodying 29 Years' Experience

ECONOMICAL EFFICIENT STURDY

ACCURATE APPLICATION—IMPROVED HEATING—QUICK SHUTOFF

NON-DRIP SPRAY BARS

★

MUNICIPAL SUPPLY COMPANY

SOUTH BEND, INDIANA

ANNOUNCING THE

BAKER

HYDRAULIC SCRAPER

The pioneer builders of tractor scrapers now offer hydraulic models in 5 cu. yd. capacity, nearly 25 per cent lighter than scrapers of like capacity (because of the use of Hi-Steel). They have less draft and even greater strength. A 35 to 40 H.P. tractor handles them.

LIGHT WEIGHT — GREAT STRENGTH — EASY LOADING — CLEAN DUMPING—MORE YARDAGE TO THE DUMP.

Accurate control by the tractor driver, down pressure for tough soils, and novel adjustments make the Model 180 an outstanding Scraper for 35 to 40 H.P. tractors.

Ask for Bulletin No. 591

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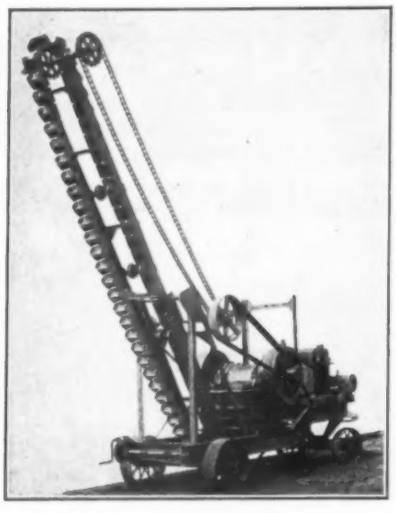
Yes—We would like you to mention ROADS AND STREETS

plate that slides under the top sheet of the pad and is printed in blue ink, showing ⅛ in. squares, every ½ in. line heavy and every 1 in. line numbered; and on the other side an isometric design with all three axes divided 1 in., ½ in. and ¼ in., so that drawings showing all six sides and interior may be made to any scale. A steel straightedge is also provided. The pad has a stiff back and is sealed at top with padding cement and at bottom with strips of reusable drafting tape, which prevents shifting. Made in pads of 200 sheets, 5½x8½; 100 sheets, 8½x11, and 50 sheets 11x17.

New Jaw Type Rock Crusher

A new jaw type rock crusher has been brought out by the Day Pulverizer Co., Knoxville, Tenn. This crusher is of the 10x20 size. The main frame or crusher base is made of a one-piece electric steel casting, heavily ribbed throughout.

The crusher is of the "overhead eccentric" type. The main shaft is made of a high-grade heat-treated alloy steel. The jaw and cheek plates are made of manganese steel. The jaw plates are reversible end for end. SKF double roll self-aligning roller



New Day Jaw Type Rock Crusher

bearings are standard in both side and eccentric bearings. The bearings are dustproof and require practically no attention at any time.

The crusher may be installed by itself on skids or may be mounted on a 2-wheel truck for operation from tractor rear power take-off, or mounted on 4-wheel truck with power unit and folding elevator, as illustrated.

Road Sweeper

A high speed road sweeper has been brought out by the W. E. Grace Co., 1821 Chestnut St., Dallas, Tex. Important features are: Anti-friction bearings on all shafts, pneumatic tires, and positive brush control. Gears are enclosed. Power for driving the 9 ft. brush is obtained from the rear wheels by steel roller chain. There are three speed combinations, which provide the proper brush speed for any sweeping requirement. Roller bearings are on

Grace 9 Ft. Road Sweeper

the wheels and gear shafts, while the brush runs on self-aligning SKF ball bearings, all of which are equipped with special dust seals. A water tank and spray attachment is available for sweeping city streets.

Devices for Subsurface Earth Explorations by Electrical Methods

The Shepard earth resistivity meter and the Lee geoscope are two new instruments announced by the American Instrument Co., Inc., Silver Spring, Md. These instruments are designed to provide a rapid, accurate and inexpensive means of conducting subsurface explorations such as locating depth and subsurface contours of rock strata, gravel beds, clay, shale, ore bodies, etc., being applicable, it is stated, to any depth from 3 to 2500 ft.

Both instruments are now in successful use for road grading operations; classification of excavation materials in highway construction; location of sand and gravel deposits; foundation exploration; determination of depths to solid bottom in marshes, etc.; location of ore bodies, water bearing strata, etc.

Through the use of the Shepard meter, engineers of the U. S. Bureau of Public Roads have developed a rapid technique that enables a crew of only two engineers and two assistants to make from 10 to 20 shallow tests in one day. The Lee Geoscope is now in use by the U. S. Bureau of Mines with equal success.

The accuracy of the measurements obtained through the use of these instruments has been definitely established by comparison with test borings or open cuts made on the same sites.

Bulletin No. 2052 is available from the manufacturer.

New Mack Truck

Rated at 16,000 lb. gross, the new model EJ, just announced by Mack Trucks, Inc., Long Island City, N. Y., is the lightest truck yet built in the regular Mack line.

The model EJ is available in four wheelbase sizes ranging from 146 to 194 in. Three tractor wheelbases are available ranging

New Model EJ Mack Truck

from 139 to 158 in. 8.25-20 tires are the maximum size used.

A 6-cylinder engine with 3½x5 in. bore and stroke powers the EJ. This engine has a piston displacement of 288 cu. in. and develops 84 h.p. at governed speed of 2800 r.p.m. The crankshaft has seven bearings and cylinder blocks are of chrome nickel.

The chassis frame of the model EJ is pressed carbon steel. It has a depth of 8 in., width of ¼ in., and a 3¼ in. flange. It is staunchly braced by three alligator jaw type cross members and two channel type cross members.

New Button Reflector

A new button reflector, placed on the market by the Federal Stamping & Engineering Corporation, 15 Lafayette St., Brooklyn, N. Y., has nine individual button lenses, each micro-focussed and hermetically sealed with separate chromium reflecting unit. It is stated that the candlepower reflection greatly exceeds the requirements and the standards of the Society of Auto-

Federal Reflex Button Reflector

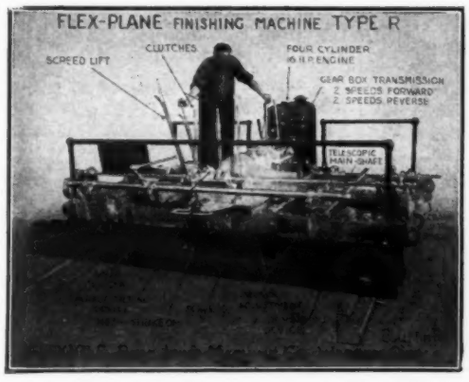
motive Engineers, the Illuminating Engineers Society, the Interstate Commerce Commission, and exceeds by far the required visibility of all distances from 50 to 500 ft. The button lenses are shockproof-mounted. The case is of heavy steel construction, baked Japan finish and triple sealed. The buttons are being used on warning signs for blind curves, railroad crossing gates, road obstructions, etc.

Bendix Announces Three New Safety Products

Frank B. Willis, vice president in charge of sales of the Bendix Products Corporation, South Bend, Ind., has announced the introduction of three revolutionary automotive products—all of a safety character.

Most unusual of the trio is the Bendix "Hydraulic Hand," an automatic steering control which eliminates the hazards connected with blowouts and contact with uneven road surfaces at high speeds. A convincing demonstration of the "Hydraulic Hand" in operation was staged for the assembled distributors when two cars of

"DO YOU KNOW?"


FLEX-PLANE FINISHING MACHINE TYPE R
SCREED LIFT
CLUTCHES
FOUR CYLINDER 45 H.P. ENGINE
GEAR BOX TRANSMISSION 2 SPEEDS FORWARD 2 SPEEDS REVERSE
TELESCOPIC MAIN SHAFT

The wide screed finishing machine is winning laurels everywhere. It produces an unbelievable smooth surface. Back screeding is only one of its features. Don't forget our contraction joint equipment.

FLEXIBLE ROAD JOINT MACHINE CO.
WARREN, OHIO

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They approve, also, the better job that results from clean material, direct from the trucks. Roadside pre-delivery of material is almost entirely done away with — as is the resulting dirt, loss of time and material and extra expense.

For accuracy, speed and low cost of spreading, and simplicity of operation,— there is no machine that compares with Buckeye.

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THE BUCKEYE TRACTION DITCHER CO. - - - - FINDLAY, OHIO

varying weight raced down a street at 60 miles per hour and as a front tire on each was blown out with a discharge from a shotgun the driver raised his hands from the steering wheel. In both cases the car maintained a straight course down the street, coming to an easy and safe stop.

The Hydraulic Hand, according to Mr. Willis, is operated on a simple hydraulic principle and can be installed on any automobile at modest cost.

Second of the products introduced is the Bendix Back-Stop, a new device which prevents a car or truck from rolling either down hill or up hill at traffic stops—enabling the operator to keep the right foot free for acceleration.

Third of the new Bendix devices announced is the Bendix Hydraulic Steering, which automatically applies power to the steering of heavy vehicles such as trucks and buses, which enables manufactures in the future to reduce steering geer ratios without reducing steering ease.

▼

Automatic Start-Stop Control and Unloader Is for Compressors

Automatic start-and-stop control, combined with automatic loading and unloading, can now be obtained without additional equipment on motor-driven single-horizontal compressors, by using the magnetic unloader introduced by Worthington Pump and Machinery Corporation, Harrison, N. J. No extra piping, valves or other devices are required.

This device operates on standard electric equipment and can be installed wherever a conventional automatic starter is used for controlling the compressor motor. The only other provision necessary is a pressure switch to operate a pilot circuit. The pressure switch control is transferred electrically from the motor starter to the magnetic unloader, and either position may be selected at will. If connected to the motor starter, the compressor starts and stops on the demand for air. When connected to the magnetic unloader, the compressor runs continuously and simply loads and unloads depending upon whether or not air is needed. If desired, the cooling water supply can also be automatically controlled.

Another unique feature in the design of this unit permits it to function as a starting and stopping unloader.

Complete information regarding the application and technical details can be obtained by writing the manufacturer.

▼

Massey to Represent Kentucky Rock Asphalt Institute

The Kentucky Rock Asphalt Institute has selected as its Washington, D. C., District of Columbia and Maryland representative George Hubard Massey of McLean, Va. Mr. Massey has been employed by the PWA for about three years. Prior to that he was consulting engineer for various engineering projects, mostly in Virginia, with headquarters at Norfolk.

WITH THE MANUFACTURERS

"Caterpillar" Export Sales and Service School

Thirty-five district representatives and dealers' envoys from foreign fields came to Peoria, Ill., on May 1st to attend a five-week sales and service instruction session at the Caterpillar Tractor Co. factory, during the month of May and the first week of June. The sessions were held under the direction of H. H. Sunderlin, manager of the Sales Training Division.

District Representatives and Dealers' Envoys at "Caterpillar" Export Sales and Service School.

Representatives and envoys attended from almost every corner of the globe. More than a dozen languages were represented. Copies of all lectures were translated into Spanish, Portuguese and French. Interpreters were provided by the company.

In the illustration, visitors, reading left to right: Front Row, Olivier Monnoyeur, Paris; Jean Walker, Egypt; Edward S. Corley, London; Thomas Pickford, Melbourne, Australia; W. F. Edgerly, Adelaide, S. Australia; E. J. Stirniman, Sydney, Australia; J. J. Sabatier, Paris, France.

Second Row: S. G. Abela, Egypt; Louis Gori, Algeria; F. C. Piercefield, Maricoba; F. Morrison, South America; Theodor J. Stracke, Montevideo, Uruguay; Adam Salazar, Bogota, Colombia; T. J. Liljinberg, Sweden; Jack Hamilton Wicks, Bahia, Brazil; D. M. Silva, Brazil; Juan Homs, Brazil; C. B. Stern, Peru; Omar Villela, Brazil.

Back Row: H. Acosta, Cuba; J. E. Dutry, Brussels, Belgium; E. W. Barnhart, India; Cecil Stark, Johannesburg, South Africa; A. Heybroek, Holland; Arthur L. Ingram, London; Gus Nyman, Cape Town, South Africa; Gerald Ilsley, Port Elizabeth, South Africa; Jesus B. Rendon, Mexico City; Jesse C. Chatham, Mexico; and Carlos Casablanca, Puerto Rico.

▼

Tractor & Equipment Co., Chicago, Ill., announces a new department of its business, logging and saw mill equipment, as manufactured by the American Saw Mill Machinery Co., New York, N. Y. Mr. Thurold Smith, of Joliet, Ill., is in charge.

Hipskind Transferred to Chicago

Mr. "Don" Hipskind of the Industrial Tractor Department of the International Harvester Co., has been transferred to Chicago, making his headquarters with the Tractor & Equipment Co., at 433 South Jefferson street.

▼

Worthington Appoints J. J. Summersby General Sales Manager

The appointment of J. J. Summersby, Assistant Vice-President of Worthington Pump and Machinery Corporation, Harrison, N. J., as general sales manager of that corporation has been announced. This appointment is an extension of Mr. Summersby's previous responsibilities, for a further concentration of direction of the corporation's general sales department. Mr. Summersby joined the Worthington Pump and Machinery Corporation as a sales engineer immediately after his completion of post-graduate work at Washington University in 1920, and has been continuously identified with the corporation since then as district sales manager, divisional sales manager, and assistant general sales manager.

▼

Sales Engineer for Toncan Culvert Mfrs' Association

H. P. Pickering

H. P. Pickering, formerly in the engineering department of the Atchison, Topeka & Santa Fe Railroad, and since connected with the U. S. Bureau of Public Roads, has joined the Toncan Culvert Manufacturers' Association, Republic Bulding, Cleveland, Ohio.

Mr. Pickering's new position is that of sales engineer of the association. His past experience equips him well for the new duties he will perform.

Asphalt Institute Establishes Field Office for Southwest

Announcement has been made of the establishment in Dallas, at 613 Southwestern Life Bldg., of a field office of the Asphalt Institute, from which will be extended to Texas, Arkansas and Oklahoma the engineering, research and promotional activities of the asphalt industry. D. D. Williamson, formerly head of the Texas State Highway Laboratories, is in charge of the Dallas office. Other offices of the Asphalt Institute are located in New York, Washington, Cincinnati, Kansas City, San Francisco, Seattle and Los Angeles.

D. D. Williams, District Engineer, The Asphalt Institute

The asphalt industry is particularly interested in the development of the Southwestern market and within the last few months the following companies have been elected to membership in the Institute: Anderson-Prichard Oil Corporation and Col-Tex Refining Company of Oklahoma City; the Cosco Oil Company and Cosden Oil Corporation of Fort Worth, and the Magnolia Petroleum Company of Dallas.

Mr. Williamson was educated at the University of Rochester, N. Y., and at the Massachusetts Institute of Technology. After serving as First Lieutenant during the war he was employed in 1920 by the Mead Fibre Co. of Kingsport, Tenn., as chemist and assistant superintendent. In 1926 he entered the employ of the Pittsburgh Testing Laboratory as laboratory head in charge of plant and field inspection of asphalt in Florida and Texas, which position he held until joining the Texas State Highway Department in 1933 as chief of laboratories.

▼

New Distributor for Byers

The appointment of the newly organized Hillsman Equipment Company, 221 North LaSalle street, Chicago, as Byers' distributors for Northern Illinois and Northwestern Indiana has been announced by P. T. Redfern, Sales Manager, The Byers Machine Co., Ravenna, O. Mr. G. E. Hillsman is president of the company. He has devoted all of his business career to the equipment industry and is, therefore, able to offer to the contracting fraternity a broad experience. Back of the Hillsman Equipment Co. lies a quarter of a century of honest and efficient service to the contractors of Illinois and Indiana, many of whom know G. E. Hillsman personally. The Hillsman Equipment Co. will handle the entire line of Byers' shovels, cranes, draglines and trenchers from 1¼ cu. yd. capacity down to the ⅜ yard, ¾ swing Bearcat, Jr., which weighs 15,000 lbs.

Patent No. 1981095

and that means a lot in

SPREADING MATERIAL

The Gibbes Spreader Attachment is designed for use in constructing and maintaining highways. It is particularly effective for applying crushed stone, gravel, slag and similar material on bituminous surface treatment roads.

It spreads smoothly, in uniform quantity and width and saves material and labor. It makes a better job. Proper spreading width is obtained by flaring the sides of the spreader box.

It is simple and substantial, cost is low and it will last indefinitely.

Each truck has its spreader securely bolted on and no time is lost. This means a great saving. The attachment can be removed in a few minutes.

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"We have not used any spreader yet that will spread stone more uniformly or that is as simple to operate. It is one of the best spreaders we have ever used."

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Also approved and used in large numbers by North Carolina Highway Department and many road builders.

Write for descriptive circulars and prices.

GIBBES MACHINERY COMPANY
COLUMBIA, S. C.

Four New Distributors for Gar Wood

W. H. Hammond, sales manager of the hoist and body division of Gar Wood Industries, Inc., Detroit, Mich., announced the recent appointment of the following distributors: Iowa Spring & Body Co., 1401 West Grand Ave., Des Moines, Iowa; Granite Alaska Garage, 45 West Granite St., Butte, Mont.; Neil's Automotive Service Co., 167 East Kalamazoo Ave., Kalamazoo, Mich.; Mason & Holsinger Co., Johnstown, Pa.

Ziegler Now With Abrams-Anderson Co.

Charles M. Ziegler, formerly construction engineer and highway commissioner of the Michigan State Highway Department, has been appointed manager of the Grand Rapids, Mich., headquarters of the Abrams-Anderson Co., road equipment distributors, 10425 Northlawn Ave., Detroit, Mich. Plans are being made for the establishment of a permanent western Michigan location which will be in charge of Mr. Ziegler, who will represent the firm in the western half of the Lower Peninsula. The company is planning to establish commodious headquarters and a warehouse in Grand Rapids to provide service for the

Air Compressor *from* FORD PARTS

Model A or B Ford Motor fitted with patented Smith Compressor Head with two cylinders for power and two compressing air. Over 60 cubic feet per minute capacity. Head equipped with high speed compressor valves. Automatic unloading and idling. Widely used to operate jackhammers, paving breakers, clay spades, tampers, riveting hammers, sand blasts, paint sprays, etc.

Low first cost, light weight, economical operation, repair parts available everywhere.

Complete machines available or Smith Compressor Head and accessories with instructions for mounting.

Write for complete information and prices.

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The Williams "Champion"
THE DIGGING DEMON

SHORTER CABLE OVERHAUL
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POWER-ARM COMBINATION GIVES GREATER DIGGING POWER

Williams Buckets master the toughest digging work in short order. Use one on your next job and see the difference in both output and profit.

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7020 Central Avenue, Cleveland, Ohio

WILLIAMS
POWER-ARM, POWER-WHEEL, MULTIPLE-ROPE, DRAGLINE ..... *buckets*

various products handled for the following companies: Bucyrus-Erie Co., Butler Bin Co., Domestic Engine & Pump Co., Le Roi Co., Independent Pneumatic Tool Co., T. L. Smith Co., Sterling Wheelbarrow Co. and others.

▼

New Distributors for O.K. Clutch and Machinery Co.

The O. K. Clutch and Machinery Co., Columbia, Pa., has added to its list of exclusive distributors the following dealers: Industrial Equipment Company, Albuquerque, N. Mex.; Industrial Machinery Co., 641 Southwest Blvd., Kansas City, Kans.; Mekeel Engineering Company, 6318 W. State St., Milwaukee, Wis.; Warren C. Shankle, 1136 Carondelet St., New Orleans. La.

▼

New Type Advertising Service Offered by W. Ellzey Brown

W. Ellzey Brown, who resigned on May 1 as general sales representative of Caterpillar Tractor Co., has established a new type of advertising service in Chicago under the title, Creative Advertising Counsel. He will represent the Western Printing and Lithographing Co., Racine, Wis., with Chicago offices at 209 So. State St. Having come up through the sales end of the business, Mr. Brown's advertising and promotional activities have been characterized by a direct and definite tie-in with sales. At Caterpillar, where he was charged with the responsibility of co-ordinating sales and advertising, Mr. Brown worked out an unusual prospectus for more efficient use of direct mail. In cooperation with the company's distributors, district representatives and the advertising department, he devised a plan whereby each distributor selected the mailing pieces desired and specified quantities needed, before the literature was actually printed. Mr. Brown was actively identified with such promotion activities as Caterpillar's Cornbelt Conference, the Diesel testimonial dinners, and various show exhibits. At Allis-Chalmers Manufacturing Co., where he was previously sales promotion manager of the tractor division, he arranged a program of tractor racing at State Fairs and directed other sales promotion activities which attracted wide attention.

▼

E. J. Mehren Resigns as President Portland Cement Association

The resignation of Edward J. Mehren, as president of the Portland Cement Association has been announced at the Association's general offices. Mr. Mehren's resignation came it was stated, because of his desire to devote his entire time to personal interests in Arizona and in the east.

Mr. Mehren was elected in 1931 as the first full-time, paid president of the Portland Cement Association which was organized in 1902.

Mr. Mehren is a member of the executive committee of the National Safety Council and of the policy committee of the Construction League of the United States. He was formerly editor of *Engineering News-Record* and vice president of the McGraw-Hill Publishing Co. The resignation will take effect Aug. 31. His successor has not yet been elected.

The Portland Cement Association, which Mr. Mehren has headed for six years, is a national organization to extend and improve the uses of concrete by scientific research and engineering field work. It has 445 employes, chiefly graduate engineers and architects, operates four research laboratories, and carries on work in 41 states, the District of Columbia and Canada. Association membership represents some 85 per cent of the cement manufacturing capacity of the United States.

▼

Ransome Appoints Representatives for District of Columbia

Paving Supply & Equipment Co., Washington, D. C., has been appointed by Ransome Concrete Machinery Co., Dunellen, N. J., makers of concrete and industrial mixers as representatives for their line of truck mixers and agitators only in the District of Columbia.

▼

Meister Now General Manager Hyatt Bearing Division

William S. Knudsen, President of General Motors Corporation, announced the appointment on May 7 of H. O. K. Meister as General Manager of the Hyatt Bearings Division, General Motors Corporation, Harrison, N. J. Mr. Meister succeeds the late Hyatt General Manager, H. J. Forsythe. Mr. Meister has been employed in various capacities in the Hyatt Division since 1914. In that year he joined the Hyatt Roller Bearing Co., the predecessor of the Hyatt Bearings Division, as assistant advertising manager in Harrison. Later he was transferred to Chicago in the sales department of the Hyatt Tractor and Implement Bearings Division and in 1920 became sales manager of that unit. In 1925 Mr. Meister returned to Harrison as general sales manager of the entire Hyatt Bearings Division and in 1929 was named assistant general manager, in which capacity he served until his appointment as general manager. Mr. Meister was born in Milwaukee 49 years ago, was educated in the Milwaukee public schools and studied in the extension department of the University of Wisconsin. Prior to Hyatt he was employed in the shops and engineering department of the Allis Chalmers Manufacturing Co.

▼

New Salesmen for Tractor and Equipment Co.

Tractor & Equipment Co., Chicago, Ill., announces the addition to its sales personnel of Mr. C. H. ("Kid") Long, formerly of Ft. Wayne, Ind. Mr. Long will make his headquarters in the Calumet District of Indiana and Illinois. Mr. George Dohm, for many years identified with the road oil business in Chicago and vicinity, has accepted a position as sales representative with the Tractor & Equipment Co. Mr. Dohm will remain in Chicago and specialize in the sale of black top road machinery.

GRACE SWEEPER

Roller bearings throughout
Gears are now enclosed
3 sweeping speeds
Only power necessary is a light truck or team.

9-ft. wire or fibre brush

Sprinkler tank available for street work

W. E. GRACE CO.

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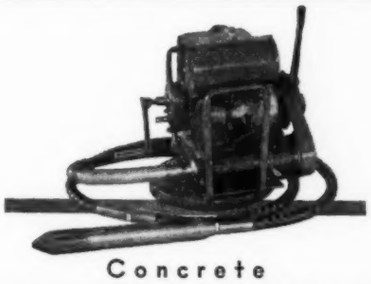

Concrete

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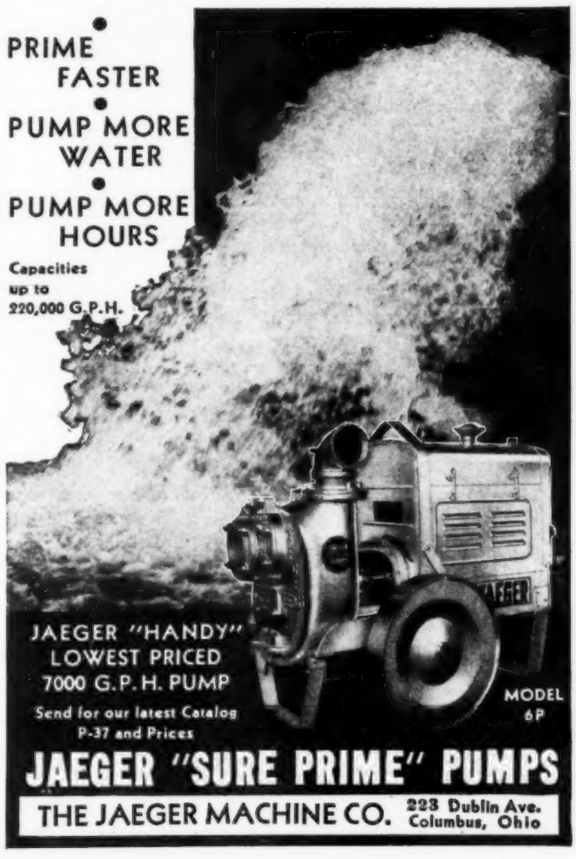
PUMP MORE HOURS

Capacities up to 220,000 G.P.H.



JAEGER "HANDY" LOWEST PRICED 7000 G.P.H. PUMP

Send for our latest Catalog P-37 and Prices

MODEL 6P

JAEGER "SURE PRIME" PUMPS

THE JAEGER MACHINE CO. 223 Dublin Ave. Columbus, Ohio

SPEED means EXTRA PROFITS

These **INSLEY** *TIME SAVERS are MONEY-MAKERS for CONTRACTORS*

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Sizes 6-9-12 cu. ft. Rocker construction gives a clean dump in vertical position. Cart will not roll while being dumped. Pneumatic tires and roller bearings make it easy to push. Stub axles carried in the frame, welded integrally with the tray. Tray completely welded, amply reinforced, free from obstruction. Ask for details and prices.

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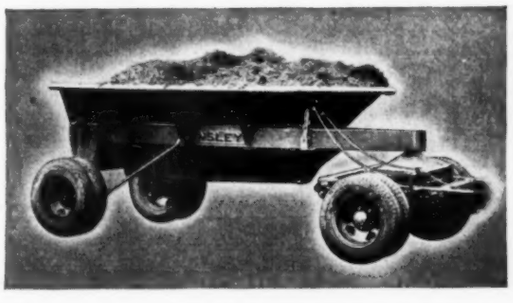
Positive control at every stage of dumping. Round apron for constant ground support. Handle at the end of the bucket makes it easy to spot the load. Made in two types: Narrow gate for restricted forms; Foundation Bucket with square gate for large masses. Write for complete information and prices.



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Hauls twice as much dirt as ordinary dump trucks, thus doubling the capacity of the fleet on dirt moving jobs. Center dump allows a quick get-away . . . strongly built for long service . . . reasonably priced. Ask for complete specifications.

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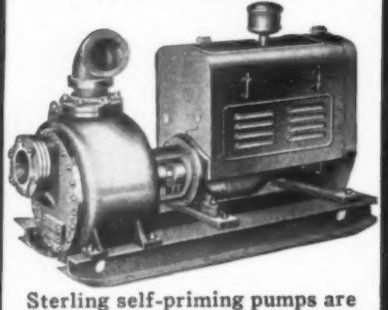

Sterling self-priming pumps are equipped with heavy-duty impellers of highly efficient design, made of wear-resisting, close-grain nickel semi-steel. The impellers are of the wide blade, open trash type and are especially designed to handle large percentages of solids. Write for new Contractors' Catalog No. 37 which tells about the many other superior features of Sterling pumps.

Sterling MACHINERY CORPORATION

411-13 Southwest Blvd. Kansas City, Mo.

NEW LITERATURE

Earth Moving Methods—A comprehensive book of 80 pages dealing with modern methods of moving earth has been issued by the Cleveland Tractor Co., Cleveland, O. The performance information given in the book is an actual compositive of time studies, engineers' data and contractors' data, based on concrete, specific jobs. The book is profusely illustrated with actual job pictures and contains information and data of much interest to contractors and engineers. The following table of contents will give some idea of what the book contains: (1) Factors That Influence Earth Moving Estimates. (2) General Statement Relative to Earth Moving Equipment. (3) Fresnos. (4) Bulldozers or Trailbuilders. (5) Self-Loading Wheelers. (6) Self-Loading Single Unit Carry Scrapers. (7) Crawler Wagons. (8) Elevating Graders. (9) Large Type, Pneumatic Tired Buggies or Wagons. (10) Sheep's Foot Tampers. (11) Rippers. (12) Estimated Cost of Operation of Tractors. (12) Short Cuts in Estimating. For each type of equipment mentioned above, figures are given showing the average yardage removed, the equipment investment required, and the estimated cost of operation. You can obtain a copy of the book from the Cleveland Tractor Co., Cleveland, O., by requesting Form Number 810.

Armco Multi Plate Bridges—"Armco Multi Plate Bridges" is the title of an attractively colored 16-page 8½x11 booklet recently published by the Armco Culvert Manufacturers Association, Middletown, O. A number of views of single, twin and triple arch bridges and a large pipe structure have been reproduced in five colors to show the possibilities of this type of construction from a beauty standpoint. But the utility side is stressed also. Copies of the booklet may be obtained free of charge by addressing the Armco Culvert Manufacturers Association, Middletown, O.

Diesel Tractors in All Lands—"Caterpillar" diesel tractors at work with trailbuilders, bulldozers, brush cutters, winches, scrapers, tamping welders and rippers, is the subject of a new booklet issued by the Caterpillar Tractor Co. Captioned photographs illustrate and explain the types of work. The attractive booklet is designated as Form 4189, and may be obtained by writing Caterpillar Tractor Co., Peoria, Ill.

Cost Charts for Calcium Chloride Stabilization.—A review of construction costs, from records of stabilization work in Indiana, Illinois, Michigan and Minnesota, shows a remarkable uniformity, when the cost of aggregates is considered separately from the cost of addition, preparation and admixing of the binder-soil and calcium chloride. Accordingly, it has been found possible and practicable to compile graphic charts from which costs for varying widths and thicknesses of stabilization can be closely estimated. Such charts, making possible the computation of costs for stabilization projects in which no new aggregates are required, as well as for those requiring the addition of aggregates, have recently been compiled by the Calcium Chloride Association and issued as Brief No. 123. Copies can be obtained upon request to the association's office, 4145 Penobscot Bldg., Detroit, Mich.

Primary Breakers and Reduction Crushers—A new bulletin featuring its primary breakers and reduction crushers has just been issued by the Smith Engineering Works, 506 E. Capitol Drive, Milwaukee, Wis. It contains descriptive matter and illustrations of the various features of the breakers and crushers, together with tables of sizes, dimensions, capacities, etc. Write the company for a copy of Bulletin 261-K.

Graders—Two new bulletins have just been issued by the Rome Grader & Machinery Corp., Rome, N. Y. Bulletin No. 73 deals with the Rome motor graders and Bulletin No. 78 with the Rome "high lift" leaning wheel graders. The machines are illustrated and described and general specifications are given. Copies of the bulletin can be obtained by writing this company.

Auto Patrols—"Caterpillar" auto patrols, the work they will do and their mechanical features are the subject matter of a booklet just issued by the Caterpillar Tractor Co. Action pictures, model views and photographic details of the features of the machine are given. The booklet is designated as Form 4052 and may be obtained without charge by writing Caterpillar Tractor Co., Peoria, Ill.

Pressure Distributor—A bulletin has just been brought out by Littleford Bros., 454 East Pearl St., Cincinnati, O., giving the whole story on the new Littleford Model C pressure distributor. Numerous illustrations together with descriptive matter are given on the important features of this new machine. A copy of Bulletin No. M-14 can be obtained by writing the company.

Dust Control and Road Soil Stabilization—A new and interesting 15-page booklet on dust control and stabilization with Columbia calcium chloride has been issued by the Columbia Alkali Corporation. The booklet is very complete. Write the Columbia Alkali Corporation, Barberton, O., for your copy.

Vertical Compressors—A compact presentation of the Worthington line of vertical single-cylinder, single-stage, air-cooled and water-cooled compressors is offered in an illustrated eight-page bulletin. Sectional views showing important features of construction, detailed specifications of the feather-type valves and other principal elements, rating tables, and dimension tables, are included. Ask for Bulletin L-621-B5. Address Worthington Pump & Machinery Corporation, Harrison, N. J.

Centrifugal Pumps—The Barnes Manufacturing Co., Mansfield, O., has just issued a bulletin illustrating and describing its new style self-priming centrifugal pumps. These pumps are truck mounted and 8 different models are offered, ranging from a 225 lb. unit with a rated capacity of 7,000 gal. per hour to an 1,850 lb. unit with a capacity of 90,000 gal. per hour. Ask for Bulletin No. 25-B.

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AMERICAN Steel & Wire Company Wire Fabric makes highways last longer. This product ties the road slab together in every direction, binding it into a strong rigid unit. It resists settling, frost heaves, and prevents many cracks. If tiny cracks should appear Wire Fabric checks their spread, holds their edges tight and reduces spalling.

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ROADS and STREETS

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WRITE for our new circular showing illustration and description of Olsen Special Bench Type Compression Testing Machine. It is designed especially for testing 2" x 4" cylinders and 2" x 2" cubes. The machine is hydraulic, having two gauges, one to half and the other to full capacity. Capacity ranges of from 20,000 to 80,000 lbs.

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